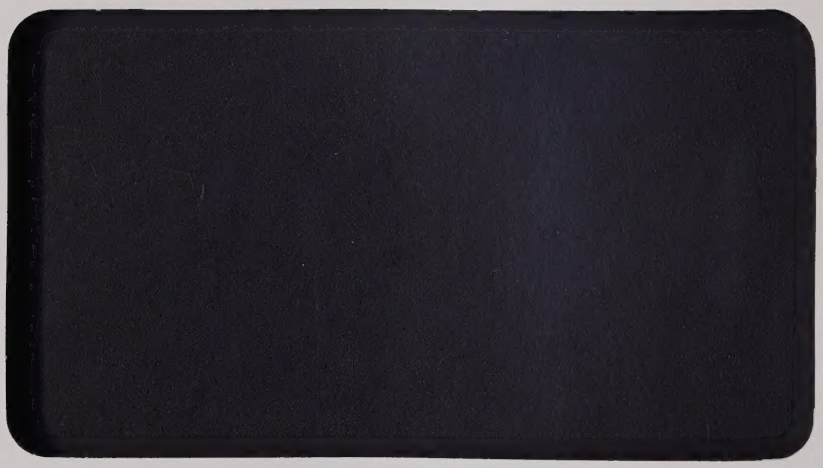
BOONTON

BOONTON ELECTRONICS CORPORATION

INSTRUCTION MANUAL

MODEL 1030
PROGRAMMABLE
SIGNAL GENERATOR



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PROGRAMMABLE
SIGNAL GENERATOR

BOONTON
ELECTRONICS CORPORATION

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6/85

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation and maintenance of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Boonton Electronics assumes no liability for the customer's failure to comply with these requirements.

THE INSTRUMENT MUST BE GROUNDED
To minimize shock hazard the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor, three prong a.c. power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to a two-contact adapter with the (green) grounding wire firmly connected to an electrical ground at the power outlet.

DO NOT OPERATE THE INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE.
Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.
Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by quailfied maintenance personnel. Do not replace components with the power cable connected. Under certain conditions dangerous voltages may exist even though the power cable was removed, therefore; always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.
Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.
Do not install substitute parts or perform any unauthorized modification of the insturment. Return the instrument to Boonton Electronics for repair to ensure that the safety features are maintained.

SAFETY SYMBOLS.

This safety requirement symbol (located on the rear panel) has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, Paragraph 5.3, which directs that and instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source. Verify that the correct fuse is installed for the power available, and that the switch on the rear panel is set to the applicable operating voltage.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

The WARNING sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

Indicates dangerous voltages.

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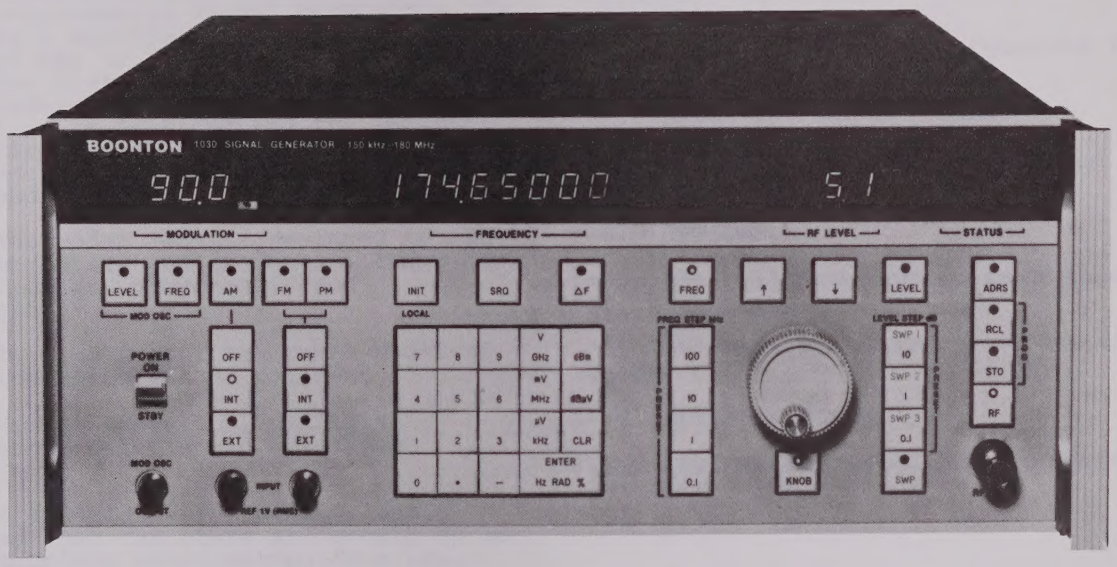

Figure 1-1. Model 1030 Programmable Signal Generator.

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This instruction manual provides general information, installation and operating instructions, theory of operation, maintenance instructions and parts list for the Model 1030 Signal Generator.

1-3. DESCRIPTION.

1-4. The Model 1030 is a general purpose, mircroprocessor based, AM/FM/PM, fully programmable signal generator. It provides a spectrally pure source of RF from 150 kHz to 180 MHz. The RF output is of low distortion and the level can be precisely controlled. Wide band modulation is provided and the internal modulation oscillator can be used as an independent, low distortion, programmable audio source.

1-5. The Model 1030 is designed to perform laboratory and production tests on RF amplifiers, components, and receivers.

1-6. The instrument has three modes of operation which are as follows:

a. Manual operation, utilizing keyboard controls and spin knob controls.

b. Stand-alone programmable audio source that can store and recall up to 250 complete panel setups from non-volatile memory, without the need for and external controller.

c. Fully compatible IEEE-488 programmable generator under external control with listen and talk modes.

1-7. The Model 1030 design features are as follows:

a. High RF output level of +23 dBm (+16 dBm with AM).

b. RF output level programmable in 0.1 dB steps.

c. Low non-harmonic spurious output.

d. Preset or user defined frequency step size.

e. Repeating step key or digital knob tuning.

f. Free format for number input, fixed or floating.

g. Very low distortion frequency modulation.

h. True phase modulation.

i. Very low distortion, variable frequency modulation oscillator whose external output can be programmed in frequency and level.

j. Recall of up to 250 complete instrument setups from a non-volatile memory.

k. Single key stroke recall of consecutive setups.

l. Flicker free sweep with intensity marker.

m. Return of function arguments via interface bus.

n. Built in test routines.

o. Detailed error identification by number.

1-8. OPTIONS.

1-9. The following option is available for the instrument:

a. -01 Rear panel RF output connection.

1-10. SPECIFICATIONS.

1-11. Performance specifications are listed in Table 1-1.

TABLE 1-1. Performance Specifications

Parameter	Specification

CARRIER FREQUENCY

Range and Resolution:

Frequency Range (MHz)	Resolution (Hz)
135.000000 - 179.999900	100
67.500000 - 134.999950	50
16.875000 - 67.499975	25
0.150000 - 16.874995	5

Accuracy and Stability: Same as reference oscillator

REFERENCE OSCILLATOR

Internal Frequency: 10 MHz, oven stabilized

Aging Rate: <±0.01 ppm/24 hours

Temperature Influence: <±0.01 ppm total variation, 0° to 50°C
<±0.03 ppm total variation, -20° to +70°C

External Frequency: 10 MHz input, TTL level, rear panel BNC connector, INT/EXT reference switch

SPECTRAL PURITY

Harmonics (RF Output Level ≤+16 dBm): -30 dBc, 0.15 to 0.5 MHz
-33 dBc, 0.5 to 67.5 MHz
-30 dBc, 67.5 to 180 MHz

Non-Harmonic Spurious: -60 dB, 0.15 to 2.1 MHz
-70 dB, 2.1 to 180 MHz

Noise Floor: -140 dBc

Residual AM: <0.008%, 0.3 to 3 kHz bandwidth
<0.02%, 0.05 to 15 kHz bandwidth

Residual FM:

Frequency	Residual FM	
MHz	0.03 to 3 kHz BW	0.03 to 15 kHz BW
0.15 to 33.8	<1 Hz	<2 Hz
33.75 to 67.5	<2 Hz	<4 Hz
67.5 to 135	<3.5 Hz	<7 Hz
135 to 180	<5 Hz	<10 Hz

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification

SSB Noise:

(Includes Phase and Amplitude Noise in 1 Hz Bandwidth, with Indicated Offset from Carrier)

Carrier Frequency	Typical SSB Noise for Offset Of:		
	10 kHz	15 kHz	20 kHz
3 MHz	135 dBc	135 dBc	135 dBc
25 MHz	134 dBc	134 dBc	134 dBc
50 MHz	130 dBc	131 dBc	132 dBc
100 MHz	126 dBc	127 dBc	129 dBc
136 MHz	122 dBc	124 dBc	126 dBc

RF OUTPUT

Range:	-142.9 dBm to +23 dBm (16 nV to 3.16 into 50 ohms) -142.9 dBm to + 16 dBm with AM
Resolution:	0.1 dB or 1.16% of the voltage
Accuracy:	±1.5 dB (+23 dBm to -50 dBm) ±2.0 dB (-50 dBm to 142.9 dBm)
Flatness:	±0.7 dB for RF output $\leq$0 dBm
Level Repeatability:	±0.2 dB
Impedance:	50 ohm
SWR:	<1.5 for levels $\leq$0 dBm
RF Interrupt:	>60 dB isolation in OFF mode
Reverse Power Protection:	Up to 50 W; externally replaceable fuse in output connector.
RF Leakage:	<1 µV at 1 inch from any surface measured with a 1 inch diameter, 2 turn loop into a 50 ohm receiver.

TABLE 1-1. Performance Specifications (Cont.)	
Parameter	**Specification**

FREQUENCY MODULATION

Deviation: For maximum peak deviation refer to column #1

Accuracy: ±(5% of reading +100 MHz) for peak deviation ≤ column #2

Frequency Range (MHz)	#1 Peak Dev.	#2 Peak Dev.
135.000000 to 179.999900	600 kHz	600 kHz
67.500000 to 134.999950	600 kHz	600 kHz
33.750000 to 67.499975	600 kHz	300 kHz
16.875000 to 33.749974	300 kHz	150 kHz
8.437500 to 16.874995	150 kHz	75 kHz
4.218750 to 8.437495	75 kHz	37.5 kHz
2.109375 to 4.218745	37.5 kHz	18.75 kHz
0.150000 to 2.109370	150* kHz	75* kHz

*For carrier frequencies below 275 kHz, FM deviation is limited to (f mimus 125) kHz peak deviation.

Resolution:

FM Deviation (kHz)	Resolution (Hz)
0 to 37.5	10
37.5 to 75	20
75 to 150	40
150 to 300	80
300 to 600	160

Harmonic Distortion:
(1 kHz Modulation Rate)

Frequency Range (MHz)	Maximum Peak Deviation for: <1% T.H.D.	<0.1% T.H.D.
135.000000 to 179.999900	600	200
67.500000 to 134.999950	400	100*
33.750000 to 67.499975	200	50
16.875000 to 33.749975	100	25
8.437500 to 16.874995	50	12
4.218750 to 8.437495	25	6
2.109375 to 4.218745	12.5	3
0.150000 to 2.109370	50**	12

*At 98.1 MHz, 75 kHz peak deviation, 1 kHz rate, T.H.D. is <0.05%.

**For carrier frequencies below 275 kHz, FM deviation is limited to (f minus 125) kHz deviation.

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification
Bandwidth (3 dB):	5 Hz to 300 kHz, (Normal Mode) DC to 300 kHz (Unlocked Mode)
Source Selection:	
Internal	20 Hz to 50 kHz
External (Front and rear BNC inputs)	1 V rms sinewave produces desired (programmed deviation). Input impedance 600 ohms
Flatness:	<±1 dB, 50 Hz to 100 kHz
FM Stereo Separation:	>45 dB, 50 Hz to 15 kHz)
Incidental AM with FM	<0.2% for deviations ≤2% f_c

PHASE MODULATION

Deviation (Maximum Peak):

Frequency Range (MHz)	Radians
135.000000 to 179.999900	16
67.500000 to 134.999950	16
33.750000 to 67.499975	16
16.875000 to 33.749975	8
8.437500 to 16.874995	4
4.218750 to 8.437495	2
2.109375 to 4.218745	1
0.150000 to 2.109370	4

Resolution:	0.01 radian
Deviation Accuracy:	±(5% of setting + 0.01) radians
Bandwidth (1 dB):	50 Hz to 15 kHz
Source Selection:	
Internal	20 Hz to 50 kHz
External (Front and rear BNC inputs)	1 V rms sinewave input for programmed deviation. Input impedance 600 ohms.

AMPLITUDE MODULATION

Depth:	0 to 99.9%
Resolution:	0.1% AM
Depth Accuracy (at 1 kHz):	±(4% of setting + 1% AM)

Distortion (at 1 kHz):

AM Depth	T.H.D.
30% AM	<0.3%
70% AM	<0.7%
90% AM	<1.0%

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification
Bandwidth (3 dB):	DC to 50 kHz, fc >2.1 MHz DC to 20 kHz, fc <2.1 MHz
Source Selection	
Internal	20 Hz to 50 kHz
External (Front and rear BNC inputs)	1 V rms sinewave input for programmed % AM. Input impedance 600 ohms.
VOR Bearing Error:	<0.1°, 108 MHz to 118 MHz
Incidental PM with AM:	<0.01 radian at 70% AM fc <2.1 MHz <0.2 radian at 30% AM fc >2.1 MHz
Incidental FM with AM:	Incidental PM x modulation rate

INTERNAL MODULATION SOURCE

Frequency Range:	20 Hz to 50.0 kHz
Frequency Accuracy:	±1% of setting, 20 Hz to 10 kHz ±2% of setting, 10 kHz to 50 kHz
Frequency Resolution:	1 Hz, 20 Hz to 249 Hz 10 Hz, 250 Hz to 2490 Hz 100 Hz, 2.50 kHz to 24.9 kHz 200 Hz, 24.9 kHz to 50.0 kHz
Output Level Range:	0 - 4.095 V rms, output impedance 600 ohms (front and rear BNC connectors)
Accuracy:	±(0.5% of setting + 1 mV), 10 mV to 4 V
Resolution:	1 mV

Distortion:
(T.H.D. for V_{out} = 1 V, RMS)

Internal

Frequency	T.H.D.
20 Hz to 249 Hz	<0.25%
250 Hz to 390 Hz	<0.05%
400 Hz to 25.0 kHz	<0.02%
25 kHz to 50.0 kHz	<0.05%

External (at MOD OSC OUTPUT)

Frequency	T.H.D.
20 Hz to 249 Hz	<0.25%
250 Hz to 10.0 kHz	<0.05%
10 kHz to 50.0 kHz	<0.15%

ANALOG SWEEP

Wide Mode (SWPI):	Fixed, overlapping segments approximately 10% of carrier frequency, with variable marker at carrier frequency. Segments for fc 2.1 MHz are 0.15 to 0.28 MHz, 0.28 to 1.35 MHz, and 1.35 to 2.1 MHz.

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification

Medium and Variable Modes (SWP2 and SWP3):

Frequency Range (MHz)	Typical Deviation (±kHz) SWP2	SWP3
135.000000 to 179.999900	2400	1200
67.500000 to 134.999950	1200	600
33.750000 to 67.499975	600	300
16.875000 to 33.749975	300	150
8.437500 to 16.874995	150	75
4.218750 to 8.437495	75	37.5
2.109375 to 4.218745	37.5	18.75
0.150000 to 2.109370	150	75

Variable Width Analog Sweep: SWP2 and SWP3 can be used with internal FM function to provide calibrated width up to FM deviation limit of carrier frequency range in use.

Analog Sweep Rates: Four selectable rates as follows: SWP1 -2, 8, 40, and 65 sweeps/second SWP2 and SWP3 -1, 10, 27, and 61 sweeps/second.

Ramp and Marker Outputs: Zero to ten volt ramp is supplied from modulation oscillator outputs. Gate signals and marker signals at TTL levels (active high and active low) are supplied through rear panel AUX connector. Model 9545011 Sweep Adapter is used for connections and rate selection.

DIGITAL SWEEP

Capability: Any subset of frequency range can be swept in steps of any size equal to or greater than resolution, provided that at least 16 steps, but not more than 4096 steps make up sweep.

Digital Sweep Rates: 800, 500, 250, and 110 milliseconds/step

Ramp and Pen-Signal Outputs: Scaled, zero to ten ramp is supplied from modulation oscillator outputs. Pen-up and pen-down signals are supplied at rear panel AUX connector. Pen can be held down throughout sweep, or dotted at each step. Levels at TTL (active high and active low). Model 954011 Sweep Adapter is used for connections and rate selection.

STEP AND KNOB OPERATION

Frequency Step: 0-15 MHz variable range
100 Hz, 1 kHz, 10 kHz, 100 kHz preset

Level Step: 0.1 dB, 1 dB, 10 dB, preset range

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification
STEP AND KNOB OPERATION (Cont.)	
Step Up (↑) and Step Down (↓) Keys	Keys increment the value of the currently active function by the appropriate step size. Holding key down will cause repetitive operation.
Knob Control:	Provides same incrementing capability as step up and step down keys. Knob control may be enabled/disabled with KNOB key.
PROGRAM STORE AND RECALL	250 complete instrument setups can be stored in locations numbered 0 to 249. Recall by location number restores all parameters and settings. Consecutive programs may be recalled by use of step up and step down keys. Store, recall, and stepped recall are fully programmable. Stored program memory is non-volatile.
GPIB OPERATION	
ANSI/IEEE Std. 488-1978 Functions:	SH1, AH1, T6, L4, SR1, RL1, DC1, DT1
Address Selections:	0 to 30 common listen/talk address. Set using front panel ADRS key.
Local/Remote Control:	Always remote enabled. When in remote, return to local message may be asserted by depressing INIT/LOCAL key.
Talk Modes:	TS Status: Returns error status. TL Learn: Returns special string for fast programming and minimal storage. TV Value: Returns value of current active function. TF Function: Returns string of five characters which indicate state of all instrument functions. Serial Poll: Returns status byte.
Status Indicators:	REM, LSN, TLK, SRQ
Options:	May be selected by internal switch EOS: Select CR, LF, or CRLF. EOI always true for last character. SRQ: Enable/disable error SRQ function does not affect SRQ key.

TABLE 1-1. Performance Specifications (Cont.)

Parameter	Specification

Typical Programming Switching Time (IEEE 488) From Start of Frequency Change:

Conditions	Time
Frequency within $\pm 3 \times 10^{-5}$ of new value	60 ms
Frequency within $\pm 1 \times 10^{-5}$ of new value	110 ms
Frequency within $\pm 5 \times 10^{-7}$ of new value	<1s

Typical Frequency-Stepping Speeds: For small frequency steps (10 kHz) with controller in "character" mode and Model 1030 in step-frequency mode:

Display Status	Steps/Sec	Time/Step
Display On	12.5	80 ms
Display Off	20	50 ms

Test Programs:
Selected by internal switch
Keyboard Switch/ Decode Test
Internal I/O Test
Frequency Control Loop Tests
Erase Program Memory
ROM Identification

OPTIONS

-01 rear panel RF output

ACCESSORIES AVAILABLE

954001 Rack Mounting Kit — Front and rear brackets

954004 Rack Slide Kit

964001 PCB Extender Card

954006 50 Ohm to 75 Ohm Transformer: 150 kHz to 180 MHz, ratio 1:1.5

103-3A 50 Ohm to 300 Ohm Balanced Transformer: 500 kHz to 110 MHz, voltage ratio 0 db± 0.75 dB.

GENERAL

Power Requirements: 100, 120, 220, or 240 volts AC ±10% 50 to 60 Hz, 100W.

Power Fail: All operating conditions restored on power up except GPIB operation returned to local. Trip level internal adjustable.

Dimensions: (Refer to Figure 1-2) 190.5 mm high x 463.6 mm wide x 641. mm deep overall (7.5 in. x 18.25 in. x 25.25 in.)

Weight: 27 Kg (58 lb) approximately

Operating Range: 0°C - 55°C; 95% RH, non-condensing

NVR Supply: Lithium primary battery 3 V, 159 mAh

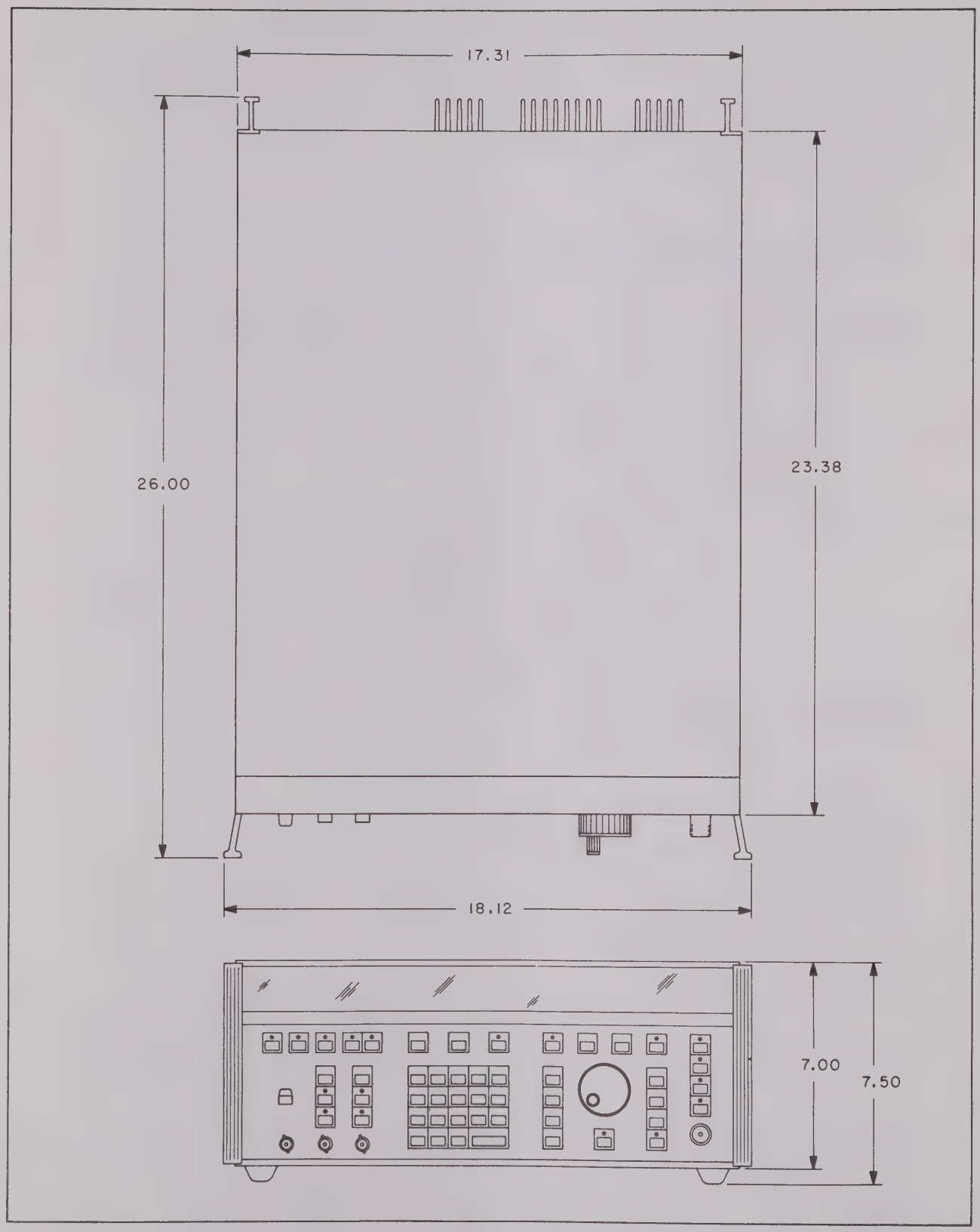

Figure 1-2 Outline Dimensions

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains the installation instructions for the Model 1030 Signal Generator.

2-3. INSTALLATION.

2-4. Unpacking. The instrument is shipped complete and is ready for use upon receipt. Unpack the instrument from it shipping container and inspect it for damage that may have occurred during shipment.

NOTE

Save the packing material and container for possible use for reshipment of the instrument.

2-5. Mounting. For bench mounting, choose a clean, sturdy, uncluttered mounting surface. For rack mounting, two accessory kits are available. Part number 950001 provides conventional rack mounting ears and rear supports. Part number 950004 provides a chassis slide mounting. All rack mounting kits contain required hardware and installation instructions.

2-6. Power Requirements. The signal generator has a tapped power transformer and two line voltage selector switches which permit operation from 100, 120, 220, and 240 volt ± 10%, 50 to 60 Hz, single phase AC power sources. Power consumption is approximately 100 watts.

CAUTION

Make certain that the line voltage selector switches are set to the correct position most nearly corresponding to the voltage of the available AC power source, and that fuses of correct rating are installed in the fuse holders before connecting the signal generator to any AC power source.

2-7. Set the line voltage selector switches S1 and S2, located on the rear panel to the appropriate positions as indicated on the LINE VOLTAGE SELECT chart. Check that the two line fuses, F1 and F2 are correct for the selected power source.

Nominal Line Voltage	F1	F2
100/120 V	2 A	½ A MDL (slow blow)
220/240 V	1 A	¼ A MDL (slow blow)

2-8. Standby Power Supply. A standby power supply not controlled by the front panel POWER switch, is active whenever the signal generator is connected to line power. Its purpose is to keep the reference oscillator crystal oven at operating temperature and to retain valid data in the random access memory.

2-9. Battery Power Supply. A battery power supply is active in the absence of line power. Its purpose is to retain valid data in the RAM. The battery is a primary lithium cell, 3.0 V and 160 mAh. The average life expectancy is five years.

2-10. Power Fail Protection. If the line voltage drops more than 10% below nominal, the power fail protection circuit automatically isolates the RAM and transfers to battery power.

Simultaneously the display shows (LO LINE), if possible, and all internal processes stop. Normal operation will resume when the nominal line voltage is restored. All conditions which existed before the event, except remote mode, will be re-established. If another power failure occurs during the restart process, the instrument will discard the previous data and perform an initialization restart.

2-11. Cable Connections. Cable connections required depend on the selected use of the signal generator. Connecting cables are not supplied. Cable connections that may be required are as follows:

a. RF Output. The RF output is available at the front panel RF OUT connector. This connector is a Type N, 50 ohms, female. For operations with load impedances other than 50 ohms, refer to paragraph 3-44. Option -01 provides a rear panel RF OUT connector of the same type instead of the front panel connector. All RF output connectors are internally fused to provide reverse power protection up to 50 watts.

b. FM Input. Front and rear panel connectors, type BNC. Input impedance is 600 ohms. Used to input an external FM/PM signal used for frequency sweeping. A 1 volt RMS signal is required for programmed modulation depth. The rear panel connector is marked EXT FM.

c. AM Input. Front and rear panel connectors, type BNC. Input impedance is 600 ohms. Used to input an external amplitude modulated signal. A 1 volt RMS signal is required for programmed modulation depth. The rear panel connector is marked EXT AM.

d. Modulation Oscillator Output. Front and rear panel connectors, type BNC. Used to monitor a buffered output signal from the internal modulation oscillator. The output level is programmable from 0 to 40 volts RMS at 600 ohms in 1 mV steps over a frequency range of 20 Hz to 50 kHz. The rear panel connector is marked MOD OSC.

NOTE

Modulation oscillator output is completely independent of the internal modulation level settings. It may be set to any value without effecting the modulation level.

e. 10 MHz Reference. Rear panel connector, type BNC. Used to monitor the internal 10 MHz reference when the selector switch is set to the INT position. This connector is also used to input an external 10 MHz, TTL reference signal, when the selector switch is set to the EXT position. The rear panel connector is marked 10 MHz REF IN/OUT.

2-12. PRELIMINARY CHECKOUT.

2-13. The preliminary checkout verifies that the instrument is operational and should be performed before the instrument is placed into use. Perform the preliminary checkout as follows:

a. Connect the power cord to the instrument and the desired power source.

b. Set the POWER switch to ON. After a two second delay the display should contain all dashes for a period of three additional seconds. This should be followed by a normal data display corresponding to the settings of the signal generator when it was last switched to STBY.

c. Depress the INIT key. This will cause the dashes to reappear for three seconds, followed by the following display:

(MODULATION)	(FREQUENCY)	(RF LEVEL)
0. Hz DEV	100.00000 MHz	0.0 dBm

1. The red LED indication on the FREQ key should be on, all other indicators should be off.

2. The INIT function sets the signal generator to a predetermined initialized state, as shown in Table 2-1.

d. The signal generator displays three sets of numerical data at a time. To determine what additional initialized states are active, depress each key listed below, observe the display to determine what states are active.

KEY	DISPLAYS MODULATION	FREQUENCY	(RF LEVEL)
Level	0. Hz Dev	100.00000 MHz	0.0 dBm
↑			0.1 dBm
↓			0.0 dBm
F		0.Hz	
PM	0.00 RAD DEV		
AM	0.0%		
MOD OSC FREQ	1.000 k Hz OSC		
MOD OSC LEVEL	1.000 V OSC		
FM	0. Hz		
FREQ	0. Hz	100.00000 MHz	0.0 dBm

TABLE 2-1. INITIALIZED STATE

Control	State
SWP mode	Off
FREQUENCY	100.00000 MHz
Frequency ΔF step size	0 Hz
RF LEVEL	0.0 dBm
PRESET LEVEL STEP dB	0.1 dB
RF ON/OFF	Off
FM/PM	Off
PM deviation	0.00 RAD
FM deviation	0.0 kHz
AM	Off
AM depth	0%
Modulation oscillator frequency	1.00 kHz
Modulation oscillator level	1 V rms
KNOB	Off
Mode	Local
SRQ	Cleared
Program number	250

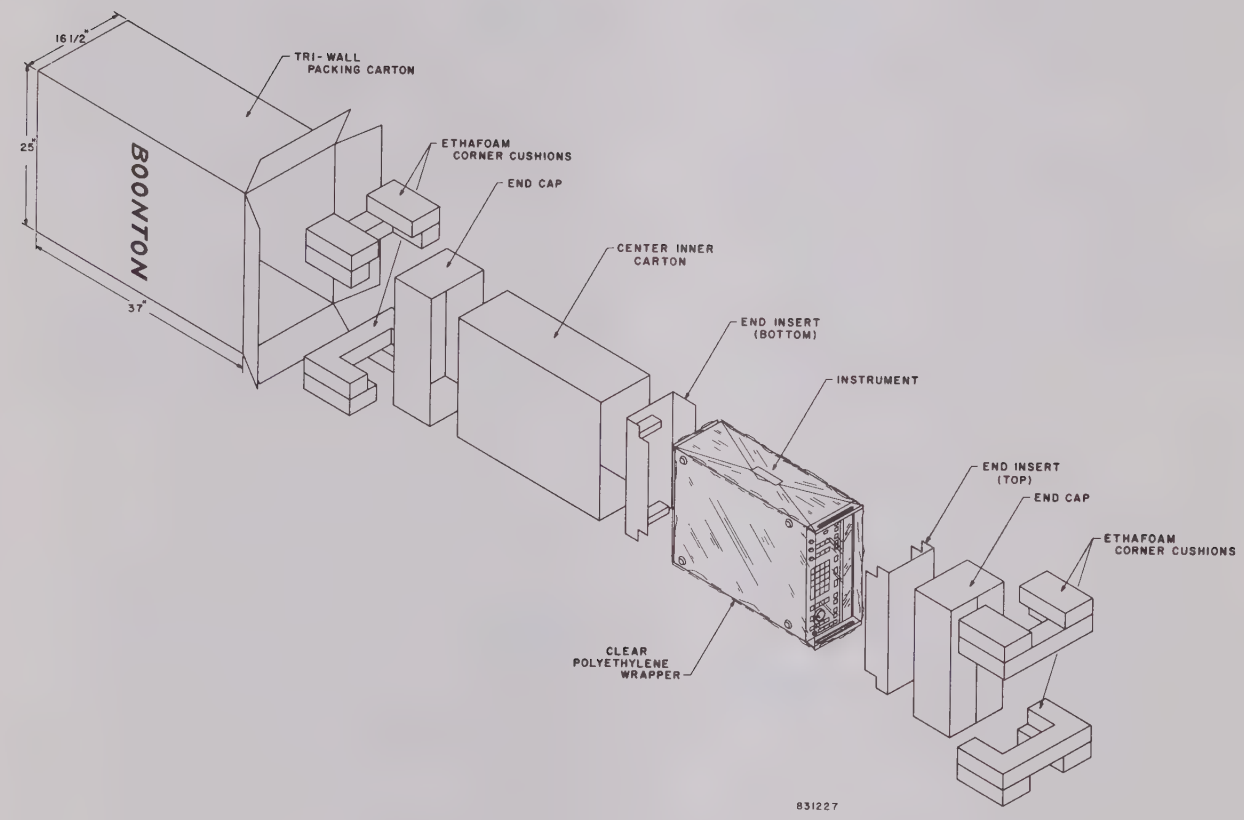

Figure 2-1. Packing and Unpacking Diagram

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. Section III contains the operating controls, indicators, and connectors description and functions, initial conditions, and operating instructions for the Model 1030.

3-3. OPERATING CONTROLS, INDICATORS, AND CONNECTORS.

3-4. The controls, indicators, and connectors are listed in Table 3-1 and shown in Figures 3-1 and 3-2.

3-5. OPERATING INSTRUCTIONS.

3-6. The operating instructions for the Model 1030 are as follows:

a. Initial conditions.

b. Local operation.

c. IEEE-488 bus operation.

3-7. INITIAL CONDITIONS.

3-8. Set the initial conditions as follows:

a. Connect the power cord to the instrument and the desired power source. Refer to paragraph 2-6 for proper power application.

b. Perform the Preliminary Checkout as specified in paragraph 2-12.

3-9. LOCAL OPERATION.

3-10. Output Frequency Selection. Select a particular output frequency as follows:

a. Set the POWER ON/STBY switch to ON.

b. Depress the FREQ key. The LED will light to indicate that the frequency function is active. Only one primary function can be active at any one time and that function will remain active until a different primary function is selected.

c. Any frequency within the range of the signal generator may be entered from the keypad using any consistent combination of numbers and units.

For example, to enter 82.150000 MHz, depress the (8) key. The FREQUENCY display will show ('8). The tick mark (') always indicates that the number displayed has not yet been entered. As the successive digits are entered, each will appear in the right most position with the previous digits left-shifted.

After entering 82.15 the display will contain ('82.15). Now depress the MHz key to complete the number and enter it. The display will now contain (82.150000 MHz). Notice that it is not necessary to enter any trailing zeros, nor is it necessary to depress the ENTER key if a units key is used. While this is the most efficient way to enter 82.15 MHz, it is equally valid to enter 82150 kHz, 82150000 ENTER, etc.

d. If at any time prior to entry the wrong digit is entered, depress the CLR key to clear the input and restore the previous frequency display.

e. Subsequent new frequencies may be entered without depressing the FREQ key each time. The function keys are used only to change the primary active function

f. After entering 82.15 MHz, depress the kHz key. This will produce the display (82150.000 kHz). Now depress the GHz key and obtain a display of (0.0821500 GHz). The display program will rescale the number to the requested units if possible; otherwise the request is ignored.

3-11. Output Level Adjustment. To adjust the output level, proceed as follows:

a. Depress the LEVEL key. The LED will light to indicate that the RF level function is active.

b. Output level may be entered in units of power ratio (dBm), voltage (μv, mV, or V), or voltage ratio (dBμV).

For example to enter -46.5 dBm, depress the (-),(4), (6), (.), and (5) keys. The RF LEVEL display will contain ('-46.5). Depress the dBm key to complete the entry. The display will now contain (-46.5 dBm).

c. The level of -46.5 dBm will appear at the RF OUT connector only if the RF key is in the ON mode. The RF key is an alternate action key and the indicated RF level is present when the LED is lit.

d. To convert the output level in dBm to an equivalent voltage across a 50 ohm load, depress any voltage units key. Because of display length limitations, the displayed units are automatically selected for optimum resolution.

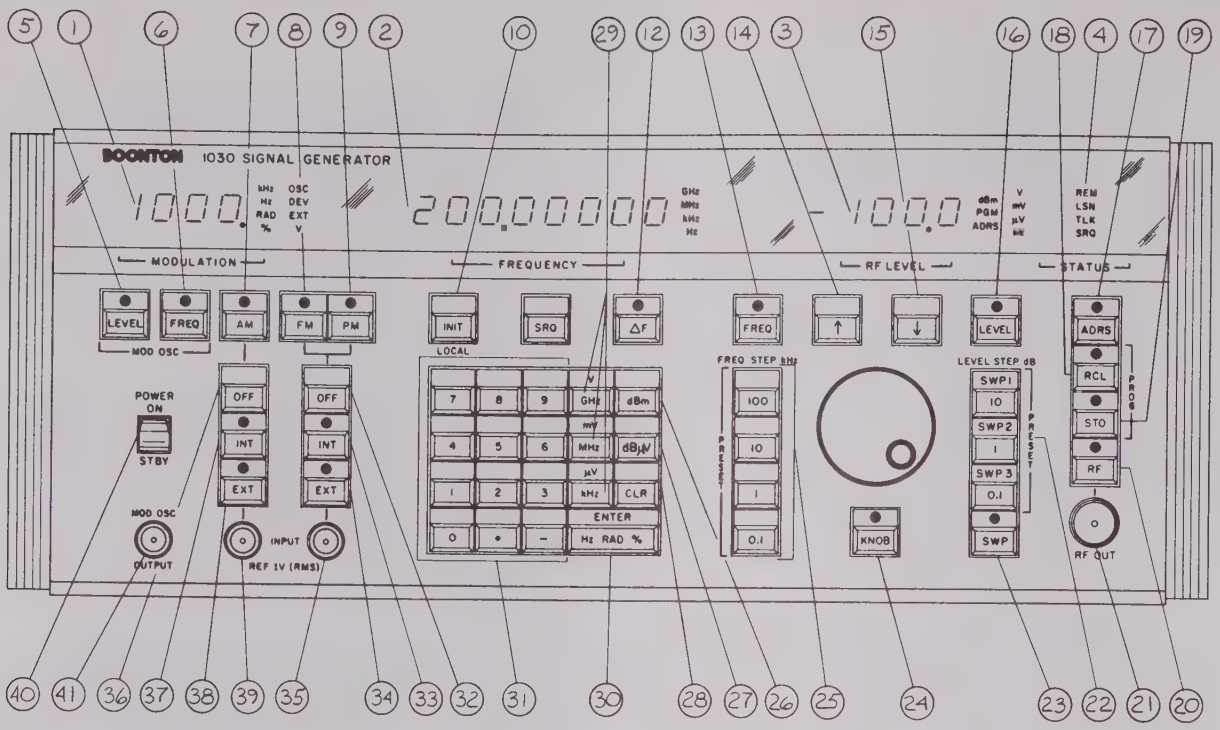

Figure 3-1. Model 1030, Front View.

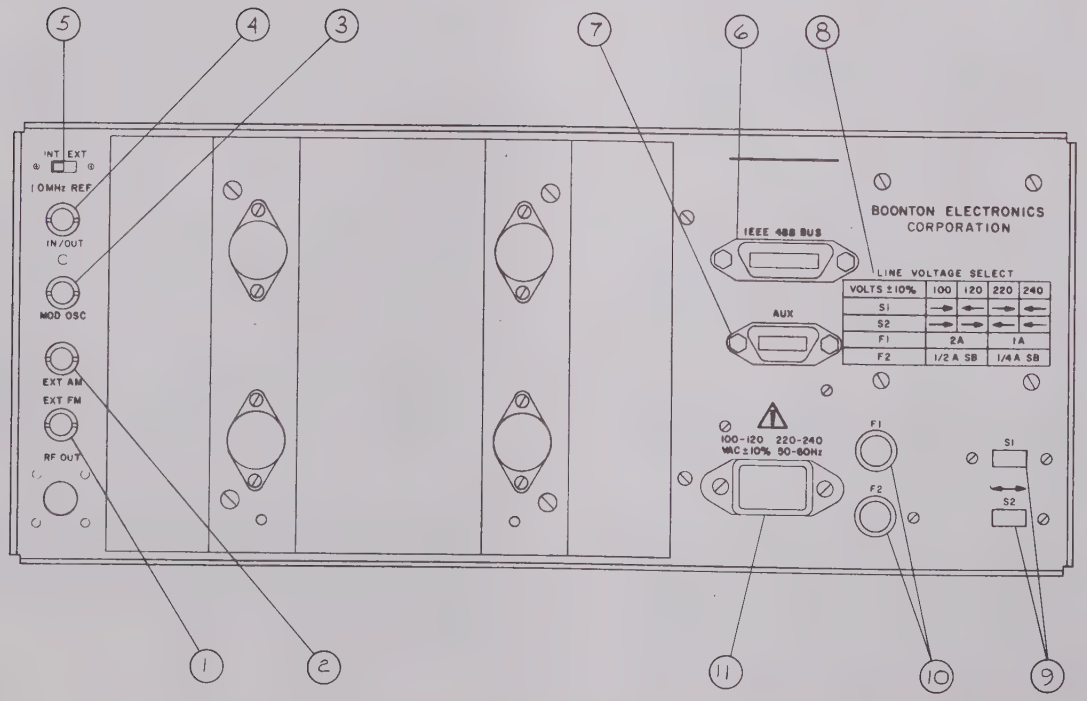

Figure 3-2. Model 1030, Rear View.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

CONTROL, INDICATOR, OR CONNECTOR	Figure and Index No.	Function
MODULATION indicator	3-1,1	Displays internally generated modulation frequency, AM depth, or FM/PM deviation depending on the active modulation key. Displays externally generated AM depth or FM/PM deviation for a 1 volt rms external modulation signal. Displays level of MOD OSC OUTPUT.
FREQUENCY indicator	3-1,2	Displays RF output frequency over a range from 150.000 kHz to 179.99990 MHz. Alternatively displays error codes or FREQ STEP size.
RF LEVEL indicator	3-1,3	Displays RF level in either dBm, µV, mV, V, or dBµV. Alternatively displays store or recall program location or IEEE-488 bus address.
STATUS indicator	3-1,4	REM, LSN, TLK, and SRQ annunciators indicate IEEE-488 bus interface activity.
MOD OSC LEVEL key	3-1,5	Selects modulation oscillator output level as the active function. Use before entering the desired value of MOD OSC OUTPUT level. This key has no effect on the internal modulation function.
MOD OSC FREQ key	3-1,6	Selects modulation oscillator frequency as the active function. Use before entering the desired modulation frequency.
AM key	3-1,7	Selects AM as the active function. Use before setting desired modulation level.
FM key	3-1,8	Selects FM as the active function. Use before setting desired modulation level.
PM key	3-1,9	Selects PM as the active function. Use before setting desired modulation level.
INIT (LOCAL) key	3-1,10	If in the LOCAL mode, sets every function to a known state. Refer to paragraph 3-16. Forces a return to LOCAL mode if in the remote mode. May be disabled by bus command (LLO) or internal switch selection.
SRQ key	3-1,11	Sets IEEE-488 bus SRQ line true. Stays true until CRL key is pressed (LOCAL mode only), bus controller executes a serial poll, or bus controller addresses the signal generator to talk. Used to request service via the IEEE-488 bus.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (CONT.)

CONTROL, INDICATOR, OR CONNECTOR	Figure and Index No.	Function
Δ F key	3-1,12	Selects frequency step size as the active function. Use before entering the desired step size. Depressing MOD OSC FREQ key after entry allows the internal modulation oscillator frequency to be stepped; depressing FREQ key after entry allows the carrier frequency to be stepped, etc. NOTE: Frequency step size cannot be stepped.
FREQ key	3-1,13	Selects carrier frequency as the active function. Use before setting desired carrier frequency.
↑ key	3-1,14	Increments the active function by the predetermined step size.
↓ key	3-1,15	Decrements the active function by the predetermined step size. NOTE: The ↑ and ↓ keys do not operate with bus address, program store, or step size functions.
LEVEL key	3-1,16	Selects RF output level as the active function. Use before entering the desired levels either in terms of dBm, or μV, mV, V, or dBμV. NOTE: Levels are set to the nearest 0.1 dB when entered as a voltage value.
PROG RCL key	3-1,18	Selects internal program recall as the active function. Use before entering the program location number, followed by the ENTER key.
PROG STO key	3-1,19	Selects internal program store as the active function. The display will indicate the program location last referenced. Use before entering new location number, followed by the ENTER key. The program is automatically stored at the specified location and the active function changes to PROG RCL. The PROG STO key must be depressed each time a program is stored.
RF key	3-1,20	Alternate action key turns the RF output on (LED on) or off (LED off).
RF OUT connector	3-1,21	Provides means for connecting RF output signal to load. Output impedance is 50 ohms, internally fused.
LEVEL STEP dB PRESET	3-1,22	Three keys select output level step size of 10, 1 or 0.1 dB in the signal generator mode; SWP1 (wide), SWP2 (medium), or SWP3 (narrow) in the sweep generator mode.
SWP key	3-1,23	Alternate action key selects the sweep generator mode (LED on) or the signal generator mode (LED off), or initiates a digital sweep.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (CONT.)

CONTROL, INDICATOR, OR CONNECTOR	Figure and Index No.	Function
KNOB key	3-1,24	Alternate action key allows the spin knob to increment the active function (LED on) or disables the spin knob (LED off).
FREQ STEP kHz PRESET keys	3-1,25	Four keys select frequency step size of 100, 10, 1, or 0.1 kHz.
dBm key	3-1,26	Selects RF output level in terms of dBm after entering desired value.
dBµV key	3-1,27	Selects RF output level in terms of dBµV after entering desired value.
CLR key	3-1,28	Clears the active function of partially entered values, restores the function to its previous value, and clears any error message. Also clears the SRQ line in the LOCAL mode.
V/GHz, mV/MHz,	3-1,29	Three keys select a voltage level entry in terms of V, mV, or µV or a frequency entry in terms of GHz, MHz, or kHz.
ENTER/Hz/Rad/%key	3-1,30	Selects frequency entry in terms of Hz, phase modulation deviation in terms of radians, or amplitude modulation in terms of %. Alternatively, enters the selected value of IEEE-488 bus, ADRS, PROG RCL, or PROG STO.
Numerical keypad	3-1,31	Provides the means of entering a numerical value as the argument for the active function, including a decimal point and a minus sign.
FM/PM OFF key	3-1,32	Turns the FM or PM channel off.
FM/PM INT key	3-1,33	Selects internal modulation source for either the FM or PM channel.
FM/PM INPUT connector	3-1,34	Selects external input for either the FM or PM channel.
FM/PM INPUT connector	3-1,35	Provides the means of connecting an external modulating signal to the input of either the FM or PM channel.
AM OFF key	3-1,36	Turns the AM channel off.
AM INT key	3-1,37	Selects internal modulation source for the AM channel.
AM EXT key	3-1,38	Selects external input for the AM channel.
AM INPUT connector	3-1,39	Provides the means of connecting an external modulating signal to the input of the AM channel.
POWER ON/STBY switch	3-1,40	Switches the power supply to ON or STBY condition.
MOD OSC OUTPUT	3-1,41	Provides means for connecting the internal modulation oscillator to an external load. Also outputs 10 V ramp voltage in sweep operation for driving oscilloscope x axis.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (Cont.)

CONTROL, INDICATOR, OR CONNECTOR	Figure and Index No.	Function
EXIT FM connector	3-2,1	Same as front panel FM/PM INPUT connector.
EXT AM connector	3-2,2	Same as front panel AM INPUT connector.
MOD OSC connector	3-2,3	Same as front panel MOD OSC OUTPUT connector.
10 MHz REF IN/OUT	3-2,4	Provides means for connecting an external 10 MHz frequency reference in place of the internal reference (slide switch in EXT position), or for outputing the internal reference (slide switch in INT position).
INT EXT 10 MHz REF	3-2,5	Selects internal frequency reference, available at 10 MHz REF IN/OUT connector, or external 10 MHz frequency reference connected to 10 MHz REF IN/OUT connector.
IEEE 488 BUS connector	3-2,6	Provides means of connecting standard IEEE-488 bus interface cable.
AUX connector	3-2,7	Provides means for connecting internal sweep generator marker and gate signals to an external display device.
LINE VOLTAGE SELECT chart	3-2,8	Lists S1 and S2 switch positions and F1 and F2 fuse values for various AC supply voltages.
S1, S2 slide switches	3-2,9	Provide means for accommodating various AC supply voltages.
F1, F2 fuse holders	3-2,10	Allows installation of proper fuse values for various AC supply voltages.
100-120,220-240 VAC ±10% 50-60 Hz connector	3-2,11	Allows connection of power cord to instrument.

In this example, the power level of -46.5 dBm will be converted to 1.05 mV, its equivalent voltage across 50 ohms. Depressing the dBm key will restore the -46.5 dBm indication.

NOTE

A 75 ohm reference can be selected using option switch A6S2-8 on the I/O board. The 75 selection will yield the correct voltage level indication if it is used with a 1:1.5 RF transformer (such as the Boonton Model 954006). The RF power level indication will be correct for either a 50 ohm load, or a 75 ohm load plus RF transformer. The reference value may also be set on the IEEE-488 bus, thereby overruling the option switch setting; the option switch setting will be restored when Initialize or Device Clear (DCL, SDL) is executed.

e. An output level may be entered in voltage units initially and displayed at any point as a voltage level or in dBm. Resolution is 0.1 dB, or about 1% in voltage.

3-12. MODULATION MODE SELECTION AND ADJUSTMENT.

NOTE

The AM and FM/PM modulation source selection keys may be operated at any time. It is not necessary for AM or FM/PM to be the active function in order to change sources. Simultaneous AM with FM or AM with PM, using any combination of sources is permitted.

3-13. Frequency and Phase Modulation. The FM and PM functions share the same internal circuits and are therefore mutually exclusive. To apply FM or PM, proceed as follows:

a. Depress the FM key for frequency modulation or the PM key for phase modulation.

b. Enter the desired deviation by means of the keypad followed by the appropriate frequency units key for FM or ENTER key for PM. The ENTER key serves as a multipurpose units key including hertz, radians, percent, and dimensionless numbers.

For example, to enter 300 kHz deviation, depress the FM key followed by (3),(0),(0) keys. The MODULATION display will contain ('300). Depress the (kHz) key to complete the entry. The display will now contain (300 kHz).

c. Entering a value for deviation does not control the modulation source. This is accomplished with the shared FM/PM source keys. The OFF key disconnects all inputs to the modulator and results in minimum residual modulation.

The INT key selects the internal modulation oscillator as the source with the specified deviation.

The EXT key selects the external source INPUT with a sensitivity of the programmed deviation. Therefore, for calibrated external source modulation, an input level of 1 V RMS (sinewave) or 2.828 V peak-to-peak (non-sinusoid) is required.

d. To enter the modulation rate, depress the MOD OSC FREQ key followed by appropriate modulation oscillator frequency and units keys.

For example, to enter a modulation rate of 1.5 kHz, depress the (1), (.), (5) keys. The MODULATION display will contain ('1.5). Depress the (kHz) key to complete the entry. The display will now contain (1.5 kHz). Note that the MOD OSC LEVEL need not be set to achieve the desired deviation and rate.

3-14. Amplitude Modulation. To apply AM, proceed as follows:

a. Depress the AM key.

b. Enter the desired depth of modulation by means of the keypad followed by the ENTER(%) key.

For example to enter 30% AM, depress the AM key followed by (3) & (0) keys. The MODULATION display will contain ('30). Depress the ENTER (%) key to complete the entry. The display will now contain (30%).

c. The modulation source selection for AM is identical to that for FM/PM and consists of three keys marked OFF, INT, and EXT.

The INT key selects the internal modulation oscillator as the source with the specified AM.

The EXT key selects the external source INPUT with a sensitivity of the programmed AM. Therefore, for calibrated external source modulation an input level of 1 V RMS (sinewave) or 2.828 V peak-to-peak (non-sinusoid) is required.

d. To enter the modulation frequency, depress the MOD OSC FREQ key followed by the appropriate modulation oscillator frequency and units key.

For example, to enter a modulation frequency of 1 kHz, depress the (1) key. The MODULATION display will contain ('1). Depress the (kHz) key to complete the entry. The display will now contain (1 kHz).

3-15. Internal Modulation Oscillator. The modulation oscillator provides an independent variable level output as well as a fixed internal level for driving the AM and FM/PM modulators. To control the MOD OSC OUTPUT, proceed as follows:

a. Depress the MOD OSC FREQ key to make the modulation oscillator frequency the active function.

b. Enter the desired frequency by means of the keypad followed by the appropriate frequency units key.

For example, to enter a frequency of 25 kHz, depress the (2), (5) keys. The MODULATION displays will contain ('25). Depress the (kHz) key to complete the entry. The display will now contain (25 kHz).

c. Depress the MOD OSC LEVEL key to make the modulation oscillator output level the active function.

d. Enter the desired modulation oscillator output level by means of the keypad followed by the appropriate voltage units key.

For example, to enter an output level of 100 mV depress the (1), (0), (0) keys. The display will contain '100. Depress the (mV) key to complete the entry. The display will now contain (0.100V).

NOTE

This parameter effects only the level at the MOD OSC OUTPUT connector. It has no effect on the internal modulation function.

3-16. Step-up and Step-down Functions. The up (↑) and down (↓) keys may be used to increment and decrement most functions in selected step sizes.

3-17. Step-up and Step-down-Frequency Functions. To step-up or step-down functions that have a frequency argument, proceed as follows:

a. If the standard preset step size is to be used, depress the appropriate PRESET FREQ STEP kHz key.

NOTE

The preset keys may be depressed at any time without regard to which function is active. If a non-standard step size is to be used, depress the F key, which makes it the active function. Enter the desired step size by means of the keypad followed by the appropriate frequency units key.

b. Depress the function key corresponding to the function to be stepped. This may be the carrier frequency, the modulation oscillator frequency, or the FM deviation. From this point on, each time the step-up key is depressed, the function argument will be changed by the step size. Holding down the step-up key will produce a single increment, followed by a one second delay, followed by repetitive increments until the key is released. The step-down key works in the same way for decrementing the argument.

3-18. Step-up and Step-down Level and Miscellaneous Functions. To step-up or step-down functions that do not have a frequency argument, proceed as follows:

a. RF Output Level. To step the RF output:

1. Depress the appropriate PRESET LEVEL STEP dB key.

2. Depress the LEVEL key. From this point on, each time the step-up or step-down key is depressed, the RF output level will change by the step size.

NOTE

These keys are calibrated in dB steps for RF output levels in ratio units. When voltage units are used the actual step size will still be in dB units, resulting in an equivalent voltage step factor. The step function will then appear to multiply the level by a factor each time rather than to add an increment.

b. Modulation Oscillator Output Level. To step the modulation oscillator output level:

1. Depress the appropriate PRESET LEVEL STEP dB key.

2. Depress the MOD OSC LEVEL key. From this point on, each time the step-up or step-down key is depressed the modulation oscillator output level will change by the step size.

c. Miscellaneous Function. The PRESET LEVEL STEP dB keys can also be used to enter a step size for % AM, or PM deviation in radians, if that particular function key is depressed after the preset value. However, in these cases the key nomenclature does not correspond to the step size; the 0.1 dB key will step the next significant digit, and so forth.

NOTE

The step size, bus address, and store program functions cannot be incremented. The recall program step size is always unity.

3-19. Spin-Knob Control. The spin knob is a digital rotation encoder with 100 steps per revolution which works in conjunction with the step-up or step-down functions to produce the action of a conventional tuning control or potentiometer. It is engaged or disengaged by alternate action of the KNOB key. When engaged the spin knob functions, proceed as follows:

a. All frequency functions: the knob uses the same step size as the step-up and step-down keys.

b. % AM, PM deviation, MOD OSC LEVEL, and RF LEVEL functions: the knob uses the smallest step size without regard to the selected step size.

NOTE

The spin knob does not operate with frequency step size, bus address, program store location, or program recall location.

3-20. Sweep Function. The red SWP key is an alternate action key which changes the function from the normal signal generator mode (LED off) to the sweep generator mode (LED on).

A choice of analog or digital sweep is provided. Setting the sweep generator mode automatically turns the modulation sources off and sets the frequency function active. At the same time, a 10 volt peak-to-peak ramp with an intensity marker pulse will appear at the MOD OSC OUTPUT connector, as well as at the rear panel MOD OSC connector, for sweeping an external display device.

Marker gate signals and retrace gate signals are available at the rear panel AUX connector for use with an external display device. These TTL level signals consist of a positive-going marker gate pulse on pin 4, negative-going marker gate pulse on pin 6, positive-going retrace gate pulse on pin 5, and negative going retrace gate pulse on pin 7.

For most applications, it will not be necessary to use the marker or gate blanking signals available at the rear panel. The swept RF signal appears at the RF OUT connector and is controlled by the RF key and output level controls. The frequency entered via the carrier frequency function becomes the marker frequency.

The three available sweep widths are selected with the keys marked SWP1, SWP2, and SWP3 in red.

Typical sweep widths for narrow (SWP3) and medium (SWP2) sweep modes are listed in Table 2-3. For the wide (SWP1) sweep mode, sweep widths are fixed, overlapping segments approximately 10 percent of the carrier frequency, with variable markers appearing at the carrier frequency. For carrier frequencies below 2.1 MHz, segments are 0.15 to 0.28 MHz, 0.28 to 1.35 MHz, and 1.35 to 2.1 MHz. A variable sweep width is available with analog sweep.

NOTE

A level step selected while in the signal generator mode is not disturbed by the sweep mode use of these same keys.

In the narrow (SWP3) and medium (SWP2) sweep modes the intensity marker appears at the center of the display and coincides with the frequency entered into the frequency function.

In the wide (SWP1) sweep mode the swept band is automatically selected by the internal control program to include the marker frequency. The position of the marker may be anywhere across the display. The marker frequency again coincides with the frequency entered into the frequency function. When the marker approaches the sweep extremes, the sweep switches to the next adjacent frequency segment. In this manner the entire frequency range of the generator is covered.

NOTE

The accuracy of the marker position is greatly enhanced in the narrow and medium sweep modes. For best accuracy, locate the region of interest using the wide mode and then change to a narrower mode for accurate frequency determination. The modulation sources must remain off during sweep; all other controls operate normally.

To display a swept waveform on an oscilloscope, proceed as follows:

a. Select a carrier frequency at the center of the desired sweep range.

b. Depress the SWP1 key to obtain as wide a sweep as possible.

c. Connect the 10 V ramp signal available at the MOD OSC OUTPUT connector to the X input of the oscilloscope. Adjust the oscilloscope X axis controls as required to obtain a display of exactly one ramp.

d. Connect the sweep voltage available at the RF OUT connector to the device under test. Adjust the sweep voltage output level as desired using LEVEL key as in normal generator operation.

e. Connect the output voltage of the device under test to the Y axis of the oscilloscope to display the swept waveform.

3-21. Analog Sweep.

NOTE

Variable width sweep is not available with SWP1. External FM with sweep is not allowed. With FM off, SWP2 and SWP3 sweep widths are as listed in Table 3-2.

a. Variable-Width Analog Sweep. The internal FM function can be used to provide a variable-width analog sweep. If the internal FM function is active during SWP2 or SWP3, the sweep width will be controlled by the FM deviation specified - 0 to the maximum FM deviation available at the carrier frequency. This feature can be programmed via the IEEE-488 bus using the corresponding sweep and FM mnemonics.

NOTE

Slow analog sweep will be useful only if the display device has storage capability because the flicker factor is too high for comfortable viewing on a non-storage oscilloscope and the sweep rate is too fast for an X-Y plotter.

b. Slow Analog Sweep. For network analyzers and similar devices that are unable to follow the high sweep rate and fast retrace of normal analog sweep, three slower sweep speeds are provided. These slower sweeps are selected by means of pins 13 and 14 of the rear-panel AUX connector, which are sensed by the microprocessor during power-up and initialize and device clear. If desired, they can be overridden temporarily by the RO-R3 bus mnemonics. Variable-width sweep can also be used at the slower rates.

NOTE

The Model 954011 Sweep Adapter supplied with the Model 1030 plugs into the rear-panel AUX connector and controls the input to pins 13 and 14. Refer to Appendix A for operating instructions.

3-22. Digital Sweep. Digital sweep provides a way to automatically increment the carrier frequency from a specified start frequency to a specified stop frequency, in specified steps. At the same time, it provides a scaled voltage ramp of fixed amplitude for use with an X-Y plotter.

a. Manual Operation. To set up digital sweep, proceed as follows:

1. Enter a start frequency and F (step size) in the usual manner.

2. Set the RF output level, and set RF to ON.

3. Store this setup in any desired location, using the normal PROG STO - #, - ENTER sequence. (Refer to paragraph 3-24.)

TABLE 3-2. TYPICAL SWEEP WIDTHS (FM OFF)

Frequency Range (MHz)	Typical Deviation (±kHz)	
	SWP2	SWP3
135.000000 to 179.999900	2400	1200
67.500000 to 134.999950	1200	600
33.750000 to 67.499975	600	300
16.875000 to 33.749975	300	150
8.437500 to 16.874995	150	75
4.218750 to 8.437495	75	37.5
2.109375 to 4.218745	37.5	18.75
0.150000 to 2.109370	150	75

NOTE

A program storage location must be used, even if storage is not required. It is unimportant which program location number is used.

4. Enter the frequency that is to the upper limit of the sweep. This frequency must be larger than the start frequency and it must allow for at least 16, but not more than 4095 total steps.

5. Press the PROG STO key, followed by the SWP key. If the conditions of step (4) above have not been fulfilled, an error message will appear. If the conditions have been fulfilled, the system will enter the digital sweep mode and the flashing message (STRTFR) will appear in the frequency display. The flashing (STRTFR) message alternates with the value of the start frequency, and indicates that the digital-sweep mode is active.

To begin a sweep, press the SWP key. The carrier frequency will be incremented by the value previously stored in ΔF and will be displayed. (The flashing message does not appear during the actual sweep.) At the same time, a voltage ramp scaled between 0 and 10 volts appears at the MOD OSC OUTPUT connector and rear-panel MOD OSC connector. This signal may be used to drive the X axis of an X-Y plotter.

Time per step may be selected from one of four preset values between 100 and 800 milliseconds/step by means of pins 13 and 14 on the rear-panel AUX connector. The selection may be overridden temporarily by use of the RO-R3 bus mnemonics. After one complete sweep, the frequency will return to the start value, as will the ramp, and the message (STRT FR) will resume flashing. Another sweep may be initiated by pressing the SWP key.

NOTE

The Model 954011 Sweep Adapter, supplied with the Model 1030, plugs into the rear panel AUX connector and its switches control pins 13 and 14.

Both dot-type and gate-type pen-lift signals are provided. (The dot-type signal is not available on R1.) The gate-type signal lowers the pen at the start of the sweep, and raises it at the end, just before reset. The dot-type signal lowers the pen at each step allowing for a short settling time to remove transients produced by either the Model 1030 or the unit under test. Both types of signals are available at both active-high and active-low. TTL logic levels at the rear panel AUX connector.

As a consequence of using a stored program location, the digital-sweep setup is stored in the same way as any other setup. Any subsequent recall of this location will re-establish the same parameters. There is no limit to the number of program locations that can be used in this manner as long as the program storage capacity of the Model 1030 is not exceeded.

Once the Model 1030 has been placed in the digital-sweep mode (either by direct setup or by recalling a previous setup), it will remain in this mode, blocking access to analog sweep, until one or more of the following events occurs:

(1) The CLR key is pressed.

(2) A program not in the digital-sweep mode is recalled.

(3) Initialize, Device Clear, or CL is sent via the IEEE-488 bus.

The CLR key will still remove errors and incomplete input without disturbing digital sweep, however, if there is neither an error nor an incomplete input present, the CLR key will cancel the digital-sweep mode and analog sweep will be accessible.

The digital-sweep mode is always identified by either the flashing message or a sweep in progress.

While the Model 1030 is in the digital-sweep mode but not actually sweeping, all controls except AM, FM/PM, and their related source switches may be used. The effect of any settings will be temporary; they will exist for only one subsequent sweep, after which the original stored conditions will be reestablished. Only parameters that are stored in the program location will repeat on subsequent sweeps.

To change the stop frequency, it is only necessary to enter a new value and press the PROG STO and SWP keys. Subject to the limitations noted above, the new digital sweep will be written over the old one in the current program location. To change the start frequency or the step size while maintaining the correct scaling, it is necessary to repeat the entire setup sequence.

Any value entered into the modulation-oscillator level function will temporarily produce a related DC level at the MOD OSC OUTPUT and MOD OSC connectors. (The knob and step-up/step-down controls operate normally in the digital sweep mode.) The scaling is such that 4.095 volts entered into the modulation oscillator level function will yield 10 volts DC output. This DC output may be used to scan manually the X axis of an X-Y plotter. When a sweep is started the ramp will always begin at zero volt.

During the sweep, keyboard controls will not respond. Only the INIT key is active, and it may be used to abort an undesired sweep. Pressing the INIT key will result in initialization, stopping the sweep and producing pen-lift and retrace. To retrieve the original setup, recall the effected program.

b. IEEE-488 Bus Operation. A digital sweep can be set up via the IEEE-488 bus interface in the same manner as in manual operation. The STSW mnemonic pair forms a macro-command to set the upper limit or stop frequency and the digital sweep mode. Single sweeps are initiated by sending the SW mnemonic. The time/step is selected by the RO-R3 bus mnemonics. The fastest mode, R1, can be made approximately 25 percent faster than is possible in the manual mode by blanking the display.

Although it may be tolerable in some cases, the above method has the disadvantage of putting the IEEE-488 bus on hold (NRFD) during the entire sweep. A more flexible and useful method is to program the sweep explicitly, step by step. By setting the modulation-oscillator frequency to zero, the modulation output becomes a DC level proportional to the value of the modulation level function. As the modulation level varies from 0 to 4095 millivolts, the DC output varies from 0 to 10 volts. The output thus forms a programmable 12-bit D-A converter, which can be used to position the X axis of an X-Y plotter to any desired

position in any sequence. Combining frequency control and ramp control with the pen-up and pen-down functions allows the synthesis of any desired type of frequency sweep.

3-23. Internal Store Recall Functions. The entire status of the signal generator, including all functions and entered values, can be saved in a program location of the non-volatile memory for recall at a later time. Up to 250 such programs can be stored and recalled.

NOTE

When the Model 1030 is shipped from the factory, certain test setups are stored in program locations 0 through 92. If possible, do not overwrite setups in these program locations; the stored test setups are useful for calibration and testing.

3-24. Internal Store Function. To save the complete front panel setup in the program memory proceed as follows:

a. Set up parameters of the generator as desired to be stored.

b. Depress the PROG STO key to make this function alive. The display location over RF LEVEL will contain the program location most recently referenced.

c. Key in the program location number desired (any location from 0 to 249) followed by ENTER.

d. The program is now saved at that specified location and the active function will automatically change to PROG RCL.

e. Repeat steps a through d for each program to be stored.

NOTE

The PROG STO key must be depressed each time a program is to be stored.

3-25. Internal Recall Function. To recall a complete front panel setup that has been stored in the non-volatile memory proceed as follows:

a. Depress the PROG RCL key to make this function active.

b. Key in the program location number desired followed by ENTER, to restore the complete status of the program.

c. If the step-up or step-down key is now depressed the next or proceeding program will be recalled (assuming such programs have been stored). In this way a sequential test procedure may be implemented.

NOTE

In normal use the internal memory is never erased. New programs or changes are simply written over the old ones. It is possible to erase the entire program memory by use of a test switch located inside the instrument. Erased programs cannot be recalled.

d. After recalling a program any panel setting may be changed manually. Depressing the PROG RCL key recalls the program most recently used. If any settings have been manually changed they will be discarded and the original values restored.

3-26. Bus Operation Store and Recall Functions. Store and recall may be used to advantage with a bus controller. The signal generator provides either temporary or long-term storage for control strings. This can be used to minimize bus traffic by storing several control setups at initialization and recalling them when needed with a simple string statement, such as:

```
(H-P BASIC) OUTPUT 718;"RE";I
```

Since few controllers have power fail protection, the data in the signal generator's non-volatile memory is secure.

NOTE

Program location 250 is a read-only setup which is the same as that provided by initialize.

3-27. REMOTE OPERATION. Any front panel operation of the signal generator, with the exception of POWER ON/STBY and KNOB control, can be duplicated in remote operation under the direction of a IEEE-488 bus controller.

3-28. Setting the Bus Address. To set the IEEE-488 listen/talk address (MLTA), depress the bus ADRS key, enter the address by means of the key pad, and use the ENTER key to complete the entry. The address may be any decimal number between 0 and 30. A secondary address is not implemented.

3-29. Entering the Remote Mode. The signal generator is put in the remote mode by addressing it as a listener with remote enable REN true. In the remote state the keyboard is disabled, except for the INIT/LOCAL key and the POWER ON/STBY switch, and the REM STATUS annunciator is on.

3-30. Return to local mode. The signal generator may be returned to the local mode as follows:

a. The INIT/LOCAL key is depressed provided local lockout (LLO) is not active.

TABLE 3-3. TALK MODES

Mode	Mnemonic	Description
Status	TS	If any error occurs, the error number (see paragraph 3-39) is returned. Zero is the normal status.
Value	TV	The argument of the active function is returned as a string. All values are in basic units (Hz, dBm, %, etc.) except RF output level voltage, which is in µV.
Learn	TL	A compressed parameter string of 79 characters, the last of which is always the ASCII ($), is returned. This string can be sent back to the signal generator to restore the exact state which defined it, but it must be sent as a complete line without alteration. When the ($) character is encountered in the input buffer, the learn mode is automatically activated. While this form provides a compact and fast method to save and restore settings, it bypasses much of the error control and therefore must be used with caution.
Program	TP	The program mode returns a six-digit number which uniquely identifies the firmware.
Function	TF	The function mode returns a string of five characters which indicates the state of all functions. The bit assignments are arranged to allow for string or byte oriented decoding. The various characters are listed in Table 3-4.

b. The go to local (GTL) bus command is sent.

c. Remote enable REN is set false.

The Local function of the INIT/LOCAL key will operate unless the bus command for (LLO) is sent. The lockout state is cancelled automatically upon REN false.

NOTE

The signal generator must be placed in the remote mode for it to store data in the local mode for execution in the remote mode.

3-31. Triggered Operation. In the remote mode the signal generator may be operated in the immediate (mnemonic IM) or wait-for-trigger (WT) mode. The immediate mode is the default condition and results in the complete execution of each instrument instruction as it is interpreted in the input buffer. The wait-for-trigger mode causes the final execution of the instructions to be deferred until the receipt of a trigger. This aids in synchronizing the signal generator state changes to the measurement system.

The wait-for-trigger mode is set when the WT mnemonic is encountered in the input string. From that point on control bytes are calculated and stored, but not executed. No change in state will occur until one of the following events occurs:

a. Group executive trigger (GET) is received.

b. The mnemonic (TR) trigger is interpreted.

c. Any mnemonic following immediate (IM) is interpreted.

NOTE

Event (c) above or go-to-local terminates the wait-for-trigger mode and restores the immediate mode. The wait-for-trigger mode is not active in local operation.

3-32. Talk Operations. The signal generator may be addressed as a talker without regard for remote/local mode. When the talker state is set by the bus controller, the signal generator sends a character string which is determined by the current talk mode. One of five different talk modes is selected by sending the appropriate mnemonic with the signal generator addressed as a listener. The selected mode will remain in effect until changed. The various talk modes are listed in Table 3-3 and Table 3-4.

3-33. End-of-String (EOS) Control. The signal generator provides several end-of-string options to accommodate a wide variety of controllers. The generator always terminates on EOI (end or identify line of the IEEE-488) true and always sends EOI true with the last character of every string. In addition,

TABLE 3-4. TF MODE

Character Decoding	Bit Position								
	8	7	6	5	4	3	2	1	0
1 Bit	0	0	0	1	1	XF	UL	IA	IF
2 Bit	0	0	0	1	1	XA	KN	SW	RF
where: XF=EXT FM	IA=INT AM			XA=EXT AM		SW=SWP			
UL=unlocked	IF=INT FM			KN=KNOB ON		RF=RF			
3 Character	0	0	0	1	1	F3	F2	F1	F0
where ASCII:	0=MOD OSC FREQ			4=FREQ		8=LEVEL			
	1=PM			5=ADRS		9=F			
	2=FM			6=PROG STO		?=MOD OSC LEVEL			
	3=AM			7=PROG RCL					
4 Bit	0	0	0	1	1	S3	S2	S1	S0
								0=SW3	
			0=ANALOG SWEEP			0=ANALOG FAST		1=SW2	
			1=DIGITAL SWEEP			1=ANALOG SLOW		2=SW1	
5 Character	0	0	0	1	1	0	L2	L1	L0
where ASCII:	0=LEVEL STEP dB 0.1			3=LEVEL STEP dB 1			6=LEVEL STEP dB 10		

CR LF, or CRLF may be used. The use of CR and LF is selected by switch positions 1 and 2 of the option switch A6S2, located at the top edge of the I/O assembly A6. For almost all applications, the condition where both switches are closed will be appropriate. The various switch combinations are listed in Table 3-5.

NOTE

The settings of option switch A6S2 have no effect on the operation of EOI.

3-34. Using Service Request (SRQ) for Error Control. The signal generator may be configured to set SRQ true when it is in the remote mode and an error occurs. This is enabled by setting the internal option switch A6S2-4 to open. The bus controller must be programmed to respond to SRQ true. In the usual case, the controller then executes a serial poll to determine which device caused SRQ to be true. If the signal generator is the requesting device, it will respond to the serial poll with a single byte which expresses the error code number in excess of 64, (see paragraph 3-39). The serial poll will clear the SRQ line automatically. The various serial poll status bytes are listed in Table 3-6.

NOTE

The action to be taken by the controller to correct the problem is completely application dependent. Soft errors generally result from errors in the controller program or from sequence errors caused by interrupting and restarting the test sequence. The error trapping capability in the generator will prevent the program from continuing to run when results would be unpredictable. A serial poll is not the only method that can be used to respond to SRQ. In small systems only the generator may be capable of using SRQ. In this situation there is no need to execute a serial poll since the identity of the requesting device is known. The error code may be obtained directly from the status (TS) talk mode (see paragraph 3-29). The SRQ line must then be cleared by sending a clear errors command (CL).

3-35. Bus Command Responses. IEEE-488 bus commands are sent by the controller to all devices on the bus (Universal Command Group) or to addressed devices only (Addressed Command Group). The response of the signal generator is listed in Table 3-7.

TABLE 3-5. EOS SELECTED

Switch A6S2-1	Switch A6S2-2	Terminators as Listener	
Closed	Closed	LF or CRLF	CRLF
Open	Closed	CR	CRLF
Closed	Open	CR	CR
Open	Open	LF	LF

TABLE 3-6. SERIAL POLL STATUS BYTES

Decimal	Hexadecimal	Interpretation
0	0	Generator is not requesting service
64	40	Panel SRQ key request
65	41	Error 1
66	42	Error 2
--	--	----------
89	59	Error 23
--	--	----------
94	5E	Error 30
--	--	----------
100	64	Error 36

TABLE 3-7. BUS COMMAND RESPONSES

Commands	Signal Generator Response
UNIVERSAL COMMAND GROUP	
Device Clear (DCL)	Same as INIT except frequency self-check test sequence is omitted.
Local Lockout (LLO)	Disables LOCAL key.
Serial Poll Enable (SPE)	Sets talk mode for poll response.
Serial Poll Disable (SPD)	Restores talk mode before poll.
ADDRESSED COMMAND GROUP	Response if MLA true; otherwise ignored.
Selective Device Clear (SDC)	Same as device clear (DCL)
Go to Local (GTL)	Sets LOCAL mode.
Group Execute Trigger (GET)	Executes any instructions pending in the wait-for-trigger mode.
ALL OTHERS	Ignored.

TABLE 3-8. PROGRAM FUNCTION MNEMONICS

Functions which take numerical arguments (only one primary function may be active at a time):

Mnemonic	Function	Argument Range
FR	RF output frequency	150 kHz-179.9999 MHz
SZ	Frequency step size	0-16.77215 MHz
FM	FM deviation	0-600 kHz, peak
PM	PM deviation	0-16 radians, peak
MF	Modulation-oscillator frequency	20 Hz-50 kHz
AM	AM depth	0-99.9%
OL	Output level	-142.9tp+23 dBm,16nV to 3.16V
ST	Store current setting in program location	0-249
RE	Recall program stored in location	0-249
ML	Modulation-oscillator output level	0-4.095 V

Units. Numbers not followed by units are assigned default units are Hz, Rad, %, dBm, or dimensionless as appropriate for the active function:

Mnemonic	Function
HZ	hz
KH	kHz
MH	MHz
GH	GHz
DB	dBm
VO	V
MV	mV
UV	µV
DU	dBµV

Modulation Source Functions:

Mnemonic	Function
XF	External FM or PM source
IF	Internal FM or PM source
FO	FM and PM off
XA	External AM source
IA	Internal AM source
AO	AM off

RF Output Control:

Mnemonic	Function
ON	RF output on
OF	RF output off

TABLE 3-8. PROGRAM FUNCTION MNEMONICS (cont.)

Step Functions. Frequency step sizes are loaded into the SZ function and are displayed as such. Output level step sizes are stored independently and do not effect SZ or the display:

Mnemonic	Function
LO	0.1 dB preset step size output level
L1	1 dB preset step size output level
L2	10 dB preset step size output level
F0	100 Hz preset frequency step size
F1	1 kHz preset frequency step size
F2	10 kHz preset frequency step size
F3	100 kHz preset frequency step size
SU	Step up
SD	Step down

Talk Mode Functions:

Mnemonic	Function
TS	Set talk mode to return error status
TL	Set talk mode to return a learn string
TV	Set talk mode to return the active argument
TP	Set talk mode to return the firmware reference number.
TF	Set talk mode to return selected functions

Display Functions:

Mnemonic	Function
UD	Enable front panel display
BL	Disable and Blank front panel display

Test Functions:

Mnemonic	Function
CH	Frequency control loop test

Trigger Mode Functions:

Mnemonic	Function
WT	Set the wait-for-trigger mode
IM	Set the immediate mode
TR	Trigger (Alternative to group execute trigger)

TABLE 3-8. PROGRAM FUNCTION MNEMONICS (Cont.)

Control Functions:

Mnemonic	Function
CL	Clear errors and SRQ
SG	Set signal generator mode
SW	Set sweep generator mode
UL	Unlock
PL	Phase lock (normal operation)
Z5*	Set 50 ohm RF volts reference
Z7*	Set 75 ohm RF volts reference
DI*	Disable SRQ function
EI*	Enable SRQ function
PU	Pen Up
PD	Pen down
S1	Set SWP1 (wide)
S2	Set SWP2 (medium)
S3	Set SWP3 (narrow)
RO	
R1	
R2	Sweep rate control per Table 3-9
R3	

*Commands overrule option switch setting until INIT or DCLR (SDC).

TABLE 3-9. SWEEP-RATE CONTROL MNEMONICS

	Setting*			Analog Repetition Rate	Digital
Mnemonic	(A1)	(A0)	SWP1	(SWP2 and SWP3)	Time/Step
RO**	1	1	40 Hz	61 Hz	500 ms
R1	1	0	65 Hz	27 Hz	110 ms
R2	0	1	8 Hz	10 Hz	250 ms
R3	0	0	2 Hz	1 Hz	800 ms

*Adaptor BEC 954011 plugged into rear-panel AUX connector.

**Default condition (adaptor BEC 954011 removed)

3-36. Program Function Mnemonics. Each front panel key is assigned a program mnemonic. Programming the mnemonic followed by unit values, if appropriate, is analogous to manual front-panel entry. In addition other program mnemonics are used for function that are applicable only in remote operation. Tables 3-8 and 3-9 list all program function mnemonics.

3-37. Number Formatting. Number formatting rules are as follows:

a. Fixed or floating formats are accepted.

b. The optional + or - sign may precede the mantissa and / or the exponent.

c. The optional decimal point may appear at any position within the mantissa. A decimal point in the exponent is ignored.

d. The optional "E" for exponents may be upper or lower case.

e. ASCII characters having hexadecimal values of 0 to 23 and 25 to 2C are ignored.

3-38. Programming Data String format. Programming data string formatting rules are as follows:

a. The programming sequence is in natural order, that is, a function mnemonic is sent first followed by the argument if appropriate.

b. ASCII characters having hexadecimal values of 0 to 23 and 25 to 2C are ignored. The ASCII ($), hexadecimal 24, is reserved. Lower case letters are automatically changed to upper case.

c. A primary function mnemonic sent without a following argument will make the specified function active.

d. The programming data string may not exceed 128 characters and may be terminated with LF, CR, and/or EOI (see paragraph 3-33).

e. Interpretation of the data string does not begin until termination occurs.

f. If units are unspecified for any argument, default units are automatically appended. The functions AM, PM, ST, and RE always use default units.

g. If a unit mnemonic is sent without a corresponding argument, the display will reflect the change provided that:

1. The units are appropriate to the active function; otherwise an error will result.

2. The display is enabled.

3. The display can accommodate the rescaled number; otherwise no change will result.

h. Errors are detected during interpretation. The occurrence of an error will display the error code if the display is enabled, and will set SRQ, if enabled by the internal option switch or by sending EI. The error and SRQ can be cleared by a serial poll, a status request (TS), or a clear error instruction (CL). All errors cause previous valid parameters to be restored. No new input can be processed until an existing error is cleared.

3-39. Error Codes. Refer to Table 3-10 for a lists of all the error codes.

3-40. Examples of Programming Strings. The following are typical examples of programming strings:

a. Simple one parameter program (TEK 4051 Basic)

```
Print @18:"FR185.6MH"
or Print @18:"FR185600000"(Hz optional)
or Print @18:"FR+1.856E+08HZ"
or Print @18:FR 1.86500E8"
or Print @18:"FR0.1856GH"
```

b. Typical receiver setup for: (75 kHz FM deviation, 400 Hz and mod rate, internal FM source, output level 10 mV, frequency step size 200 kHz, frequency 88.1 MHz, carrier on).

```
Print @18:
"FM75KHMF4001FOL10MVSZ200KHFR88.1MHON"
```

c. To step frequency through the FM band channels, send b above, followed by:

```
Print @18:"SU" for each change.
```

d. To minimize response time, use the wait-for-trigger mode.

For example:

```
Print @18:
"WTAM50MFIKHIAOL-10DBSZ20KHFRIMHON"
```

NOTE

The string is received and interpreted but previous outputs remain unchanged until group execute trigger is sent.

3-41. Options Switch A6S2. The options switch, which is located at the top right side of I/O board A6, consists of eight lever switches that control various optional features. The option switch is read by the microprocessor at power-on, INIT, DCLR, and SDC. If a switch position is changed with the

instrument on, nothing will occur until the switch is read. In some cases, the switch setting can be overruled by sending a mnemonic instruction over the GPIB, but the effect will be temporary. Option switch positions are summarized in Table 3-11 and are explained below:

a. Switches S1 and S2. These two switches determine the GPIB end-of-string (EOS) character(s). Refer to paragraph 3-32 and Table 3-4.

b. Switch S3. Switch S3 controls the AM limit error function. With the switch closed (on), any attempt to turn on AM will be blocked if the RF level is greater than +16.0 dBm, and the message (Error7) or (Error8) appears. This is the normal mode of operation. With switch S3 open (off), the AM limit error function is disabled, and AM may be turned on without regard for the RF level. The purpose of the AM limit error function is to prevent overloading of the instrument output amplifier on modulation peaks. With the protection disabled, the user must be responsible for monitoring the output to avoid saturation and clipping. This mode of operation should not be selected unless the testing to be done requires AM at high levels, and adequate monitoring is possible.

c. Switch S4. Switch S4 controls SRQ. Refer to paragraph 3-34. The switch setting can be overridden temporarily by bus mnemonics EI (enable SRQ) and DI (disable SRQ).

d. Switches S5, S6 and S7. These switches are reserved for possible future use.

e. Switch S8. This switch selects the impedance reference for RF output voltage calculations. With switch S8 closed (on), a 50 ohm impedance is assumed. This is the normal operating mode. With switch S8 open (off), all RF voltage calculations assume a 75 ohm load. It is further assumed that a 1:1.5 RF transformer, such as the Boonton 954006, is used. The RF transformer may have a frequency range that does not exactly correspond to that of the Model 1030. If this is the case, accurate results cannot be expected if the frequency of measurement is not in the bandwidth of the RF transformer. In addition, the RF transformer will have a small loss of a few tenths of a dB. This can usually be ignored, but may be accounted for if known. The switch S8 selection may be overruled during remote operation by use of the Z5 and Z7 mnemonics.

TABLE 3-10. ERROR CODES

ERROR CODE	DESCRIPTION
(1)	Illegal carrier frequency. The carrier frequency must be between 150 kHz and 179.999900 MHz. A negative frequency number is allowed and sets the UNLOCKED mode.
(2)	Illegal FM deviation. The FM deviation must be between 0 and the maximum allowed for the current carrier frequency. This may be as large as 600 kHz or as small as 37.5 kHz (see Table 1-1). This error will not occur if the FM source is OFF unless >600 kHz.
(3)	Illegal AM depth. The percent AM must be between 0 and 99.9%.
(4)	Illegal internal modulation-oscillator frequency. The modulation oscillator frequency must be between 20 Hz and 50 kHz, except for 0, which is a special case for sweep operation.
(5)	Illegal step size. The step size must be between 0 and 16.77215 MHz.
(6)	Illegal RF output level in dBm. The RF output level must be between -142.9 and +23.0 when specified in dBm, between -35.9 and +130.0 when specified in dBμV into 50 ohms, or between -34.2 and +131.7 when specified in dBμV into 75 ohms.
(7)	With AM on, output level is limited to +16 dBm. The RF output level cannot be increased above +16 dBm if either AM INT or FM EXT is ON. This is true even if the percent AM is 0.0. This error trap can be disabled by means of the option switch (refer to paragraph 3-41.)
(8)	AM cannot be turned on with output level above +16 dBm.

TABLE 3-10. ERROR CODES (Cont.)

ERROR CODE	DESCRIPTION
(9)	The primary active function cannot be stepped. The step size function (F), the bus address function, and the program store function cannot be incremented or decremented using the ↑ or ↓ keys.
(10)	Illegal modulation frequency output level. The modulation oscillator output level must be between 0 and 4.095 volts.
(11)	Units error. Units do not match primary active function. The units function does not match the active function. For example, if FREQ is active, pressing the dBm or dBμV key will cause the error.
(12)	Illegal program number. The program location number must be between 0 and 250.
(13)	Program requested is empty. The program location recalled has not had a setup stored in it since the memory was last erased; therefore, it is empty. A setup can be stored in this location.
(14)	Illegal Listen/Talk address. The listen/talk address for GPIB operation must be between 0 and 30. This includes all possible primary addresses. Some controllers may restrict this range or reserve certain values. Check the controller instruction manual.
(15)	Display overflow. Too many characters entered. The number of digits entered is limited to the size of the display. Hidden entry of significant digits is not allowed. This restriction does not apply to remote data entry.
(16)	Non-existent function mnemonic. The data string received over the GPIB contains a mnemonic which is not understood by the Model 1030. This may be due to a programming error or to a bus malfunction.
(17)	Illegal learn-mode string format. An illegal learn mode string has been received on the GPIB. The learn mode string must have been generated by a Model 1030 to be valid. It must consist of exactly 79 characters, all printable, ending with '$'. It must be first in the input buffer and must not be followed by other data.
(18)	I/O buffer overflow. Input string exceeds 128 characters. The GPIB input buffer has been over filled. The buffer can hold up to 128 characters before an end-of-string is recieved. Since spaces and certain other symbols are skipped, a typical message may be even longer than 128 characters. If 128 characters have been stored and EOS is not received, the entire buffer is cleared and the error message is sent. This error is most often the result of forgetting to send the EOS or EOL terminator in a byte mode program sequence.
(19)	FM deviation is limited to (f_C-125) kHz at low end. For carrier frequencies below 275 kHz the FM deviation is further restricted beyond the limitations of error (2). The deviation is limited to (f_C-125) kHz in order to prevent the instantaneous frequency from going below 125 kHz.
(20)	Illegal RF output voltage. The RF output voltage must be between 14 nV and 3.16 V for 50 ohms, or between 18 nV and 3.87 V for 75 ohms.
(21)	Illegal PM deviation. The PM deviation must be between 0 and the maximum allowed for the current carrier frequency. This varies from 16.0 radians down to 1.00 radian. If the FM/PM source is OFF, this error will not occur unless >16.0 radians.

TABLE 3-10. ERROR CODES (Cont.)

ERROR CODE	DESCRIPTION
(22)	Program is recall only. Program location number 250 is fixed at the initialization values. It is used for recall only, and cannot be used as a storage location.
(23)	Illegal sweep mode operation. During sweep operation, certain functions are locked out. For example, AM is not permitted during sweep. This error will occur if any disallowed action is taken.
(24)	Unlock not available with sweep. The unlocked mode cannot be used with sweep, analog or digital.
(25)	Stop frequency lower than start frequency. The digital sweep can provide only increasing frequency sweeps; therefore, the stop frequency must always be greater than the start frequency.
(26)	Fewer than 16 steps not allowed. The digital sweep must consist of at least 16 steps. If $(f_{stop}-f_{start})/f_{step}$ is less than 16, the parameters will not be accepted.
(27)	More than 4095 steps not allowed. The digital sweep cannot provide more than 4095 steps. If $(f_{stop}-f_{start})/f_{step}$ is greater than 4095, the parameters will not be accepted.
(30-36)	Hardware error. Maintenance action required. These error codes indicate a malfunction of the frequency synthesis circuits. They may appear any time the carrier frequency is changed. In many cases, the CLR key will remove the error message temporarily. If the error message recurs, maintenance is required.
(50)	Hardware multiply-divide malfunction. This error is set by a malfunction of the hardware multiply-divide circuits. It is effective only at power on and requires maintenance. The Model 1030 will not proceed with the power on procedure if this error occurs.

NOTE: The error code as shown above will appear in the center display and will be returned by the talk-status function if executed. The SRQ status byte will consist of the above code expressed in excess sixty-four. The status code 64 decimal means the SRQ was activated by the front panel SRQ key rather than by an error.

TABLE 3-11. OPTIONS SWITCH A6S2

Switch	Function	Reference	Factory Setting
S1/S2	EOS Selected	Table 3-5	Closed (both) CRLF/EOI
S3	AM Limit	Para. 3-41	Closed (enabled)
S4	Error SRQ	Para. 3-34	Open (enabled)
S5	Spare		
S6	Spare		
S7	Spare		
S8	Z Select	Para. 3-41	Closed (50 ohms)

3-42. APPLICATION NOTES.

3-43. Introduction Paragraphs 3-44 through 3-52 present typical application data for the signal generator. The signal generator is an extremely versatile instrument with many possible test applications, including circuit characterization, transmitter simulation, local oscillator substitution, and receiver measurements. Use of the signal generator is therefore, in no way restricted to the applications covered in the following paragraphs; the application data is included merely to cover a few typical or specialized applications.

3-44. Impedance Matching. The output circuits of the signal generator are designed for operation into unbalanced, 50-ohm loads; therefore, the signal generator can be used to drive most loads directly. RF transformer, Boonton 954006, which is supplied with the instrument, enables the instrument to drive 75-ohm loads directly. Refer to paragraph 3-11. The output circuit design does not preclude use with balanced loads, or with loads having impedances other than 50 or 75 ohms. When a matching network is employed, an appropriate correction factor must be applied to the readings of RF LEVEL display.

NOTE

The RF LEVEL will indicate the correct output level at the RF OUT connector when an impedance matching network is used. The actual signal level at the load, however, may be greater or smaller than the indicated level, according to the nature of the network. Proper correction factors can be calculated, provided that circuit parameters are accurately known. In the event that the characteristics of the network are unknown, measurements should be made between input and output under loaded conditions, with a sensitive RF millivoltmeter, such as the Boonton Electronics Model 92B or Model 9200.

3-45. Consider the case where an output load impedance higher than 50 ohms is required. A network similar to that shown in Figure 3-3 can be used.

3-46. For example, if the output load (and desired source impedance) is 75 ohms: R_1=43.3 ohms, R_2=86.6 ohms.

A correction factor of 0.634 or 3.96 B must be applied to the indicated RF LEVEL. A different correction factor must be applied to determine the power delivered to the load because the impedance has been changed.

Power loss (in dB)=
$20 \log_{10}(R_1+R_L)/R_L+10 \log_{10}R_L/50$,

or the delivered power, can simply be calculated from:

$$P=E_L^2/R_{10}.$$

In this example, power loss in dB= 3.96 dB + 1.76 dB=5.72 dB. If the RF LEVEL indication is -10 dBm, the power in the load is the sum of indicated level and the attenuation of the matching network, or (-10 dBm)+ (-5.72 dB)=15.72 dBm.

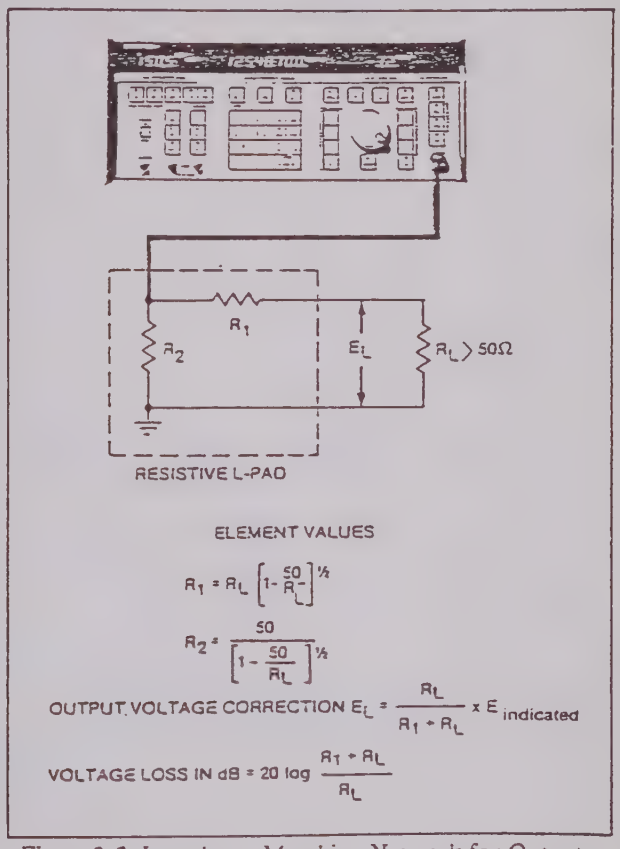

Figure 3-3 Impedance Matching Network for Output Load Impedance Higher Than 50 Ohms

3-47. In cases where a source impedance of less than 50 ohms is required to drive a low impedance load, a minimum loss matching pad of the configuration shown in Figure 3-4 is recommended. The formulas for calculation of the values of the matching pad are included as part of Figure 3-4.

3-48. Several standard tests for measuring receiver sensitivity (as defined by EIA Std RS-204-Minimum Standards for Land-Mobile Communication FM or PM Receivers) define the source voltage as that developed at the generator output under open circuit conditions where the generator source impedance is 50 ohms. In Figure 3-5, this is the voltage measured between terminals A and B when the load is disconnected.

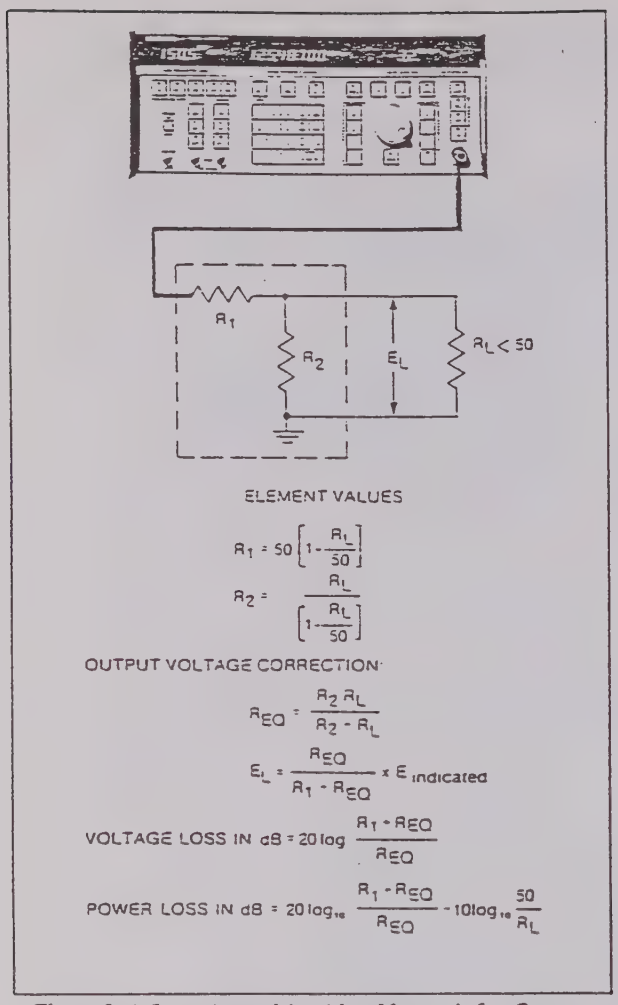
R_1
R_2
E_L
$R_L < 50$
ELEMENT VALUES
$R_1 = 50\left[1-\frac{R_L}{50}\right]$
$R_2 = \frac{R_L}{\left[1-\frac{R_L}{50}\right]}$
OUTPUT VOLTAGE CORRECTION
$R_{EQ} = \frac{R_2 R_L}{R_2 - R_L}$
$E_L = \frac{R_{EQ}}{R_1 - R_{EQ}} \times E_{indicated}$
VOLTAGE LOSS IN dB $= 20 \log \frac{R_1 - R_{EQ}}{R_{EQ}}$
POWER LOSS IN dB $= 20 \log_{10} \frac{R_1 - R_{EQ}}{R_{EQ}} - 10 \log_{10} \frac{50}{R_L}$

Figure 3-4 Impedance Matching Network for Output Load Impedance Lower Than 50 Ohms

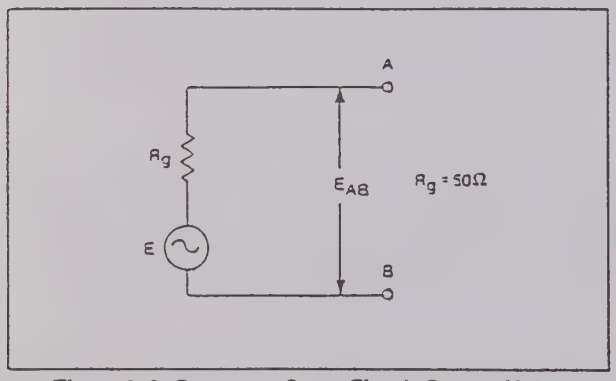

Figure 3-5 Generator Open Circuit Source Voltage

3-49. The Model 1030 signal generator, however, is calibrated to read the voltage appearing at terminals A and B with a matched 50 ohm load connected. To facilitate this measurement, a matched 6 dB pad of the form shown in Figure 3-6 should be used. With this network connected between the signal generator and the receiver, the RF LEVEL indication of the signal generator is the correct open circuit voltage required for this test.

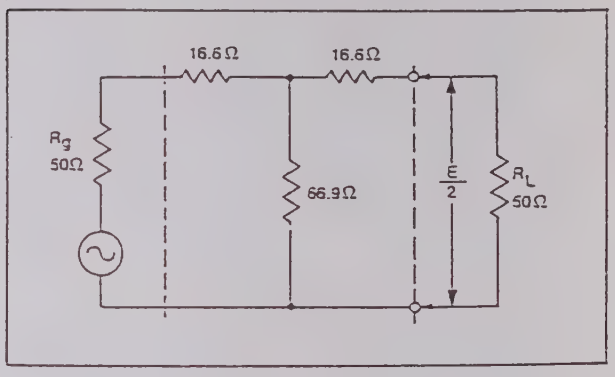

Figure 3-6 Matched 6 dB Pad

3-50. For connection to receivers with balanced input terminals, a balun should be used to provide a balanced output voltage from the signal generator. For example, assume that it is desired to match the signal generator to a 300 ohm balanced input. First, the 50 ohm source impedance of the signal generator can be converted to a 75 ohm source through use of the Boonton 954006 RF transformer, or in a manner described in paragraph 3-46. Next, the 75 ohm unbalanced load output can be connected to a 300 ohm balanced output by use of a 4:1 balun transformer as shown in Figure 3-8. The entire network can then be represented by Figure 3-8. A correction factor for the output voltage must be applied. In the arrangement shown in Figure 3-8, the 75 ohm section drops the output voltage approximately 4 dB below that indicated by the signal generator RF LEVEL. The balun, conversely, increases the voltage by 6 dB, assuming it to be lossless. The overall result is a load voltage approximately 2 dB higher than the indicated RF LEVEL.

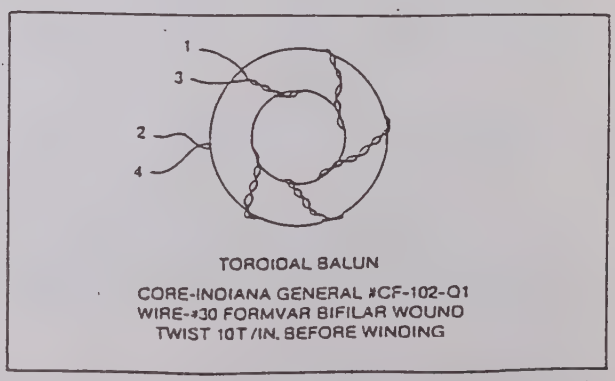

Figure 3-7 Toroidal Balun Construction Details (used in the circuit of Figure 2-8)

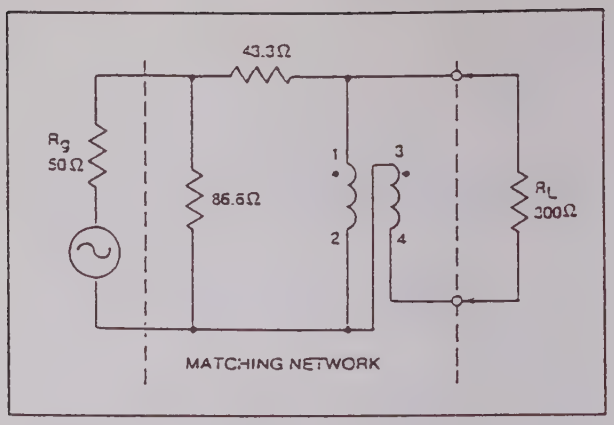

Figure 3-8 300 Ohm Balanced Matching Network

3-51. Alternate configurations for balun construction are shown in Figure 3-9 and 3-10. The configuration shown in Figure 3-9 will exhibit a relatively wideband response, while the configuration shown in Figure 3-10 will have a fairly narrow range because of the use of a resonant line section.

3-52. IF Response. The wide bandwidth required of many IF amplifiers is often attained through use of stagger-tuned, or overcoupled, double-tuned circuits. Alignment of such circuits, or checking of their response characteristics, is facilitated through use of the Model 1030 as a sweep generator.

A typical test arrangement is shown in Figure 3-11. The operation of the Model 1030 as a sweep generator is covered in paragraphs 3-20 through 3-22.

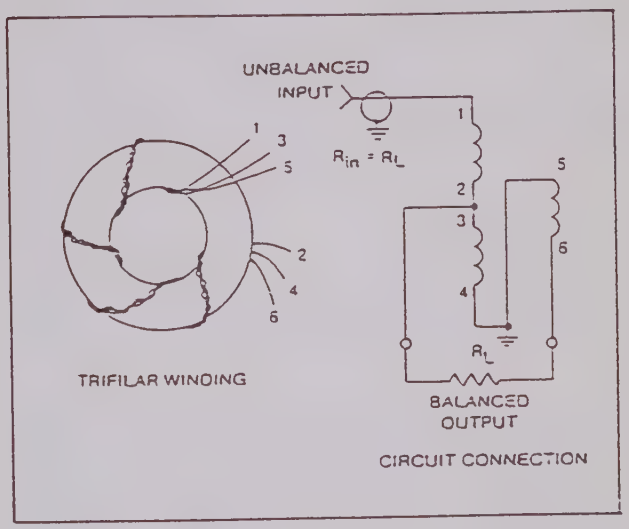

Figure 3-9 Wideband Response 1:1 Toroidal Balun

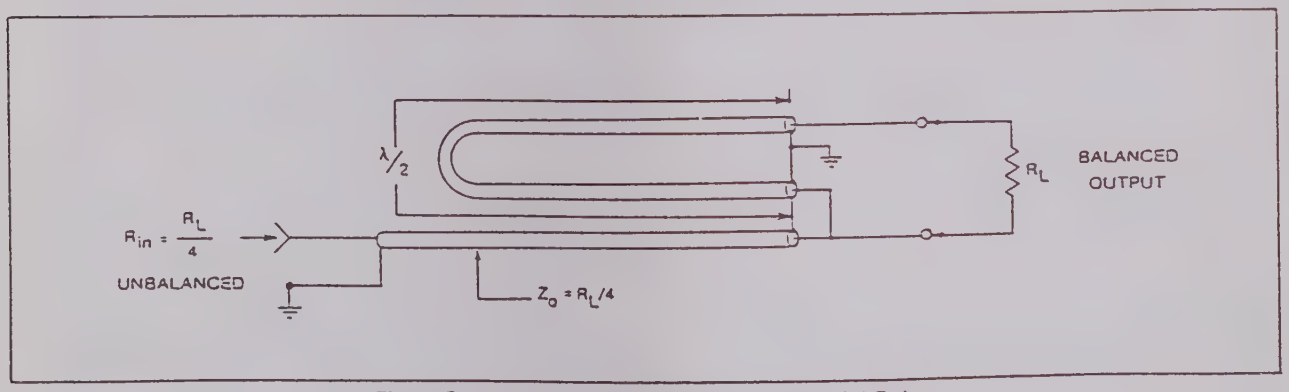

Figure 3-10 Narrowband Response 4:1 Coaxial Balun

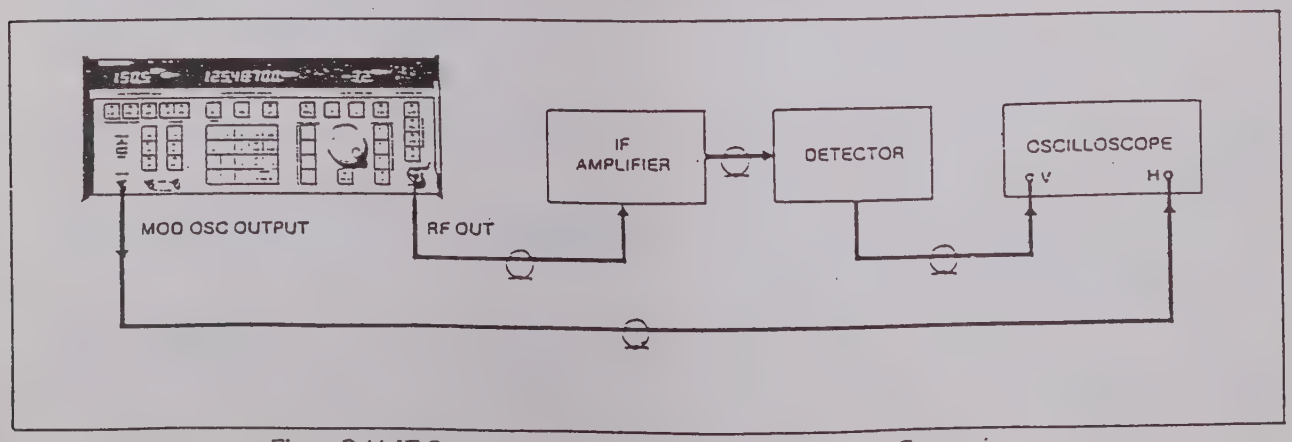

Figure 3-11 IF Response Measurement, Typical Equipment Connection

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains the functional block diagram description and detailed circuit description for the Model 1030.

4-3. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION. (Refer to Figure 4-1.)

4-4. Control of instrument operation is exercised by a microprocessor that executes a fixed program resident in read-only memory (ROM). Timing of microprocessor operations is controlled by an internal 2.5 MHz clock. A random-access memory (RAM) provides storage capability for microprocessor data.

To ensure retention of data in storage, the non-volatile RAM is powered continuously from a standby power supply (when the instrument is connected to an AC power source) or from an internal 3 volt lithium battery. The standby power supply also supplies +24 volts DC to the oven of a crystal controlled reference oscillator that determines the instrument accuracy and stability and +5 volts to enabling circuits of the main power supply.

The main power supply develops most of the DC operating power required by the instrument. Low noise power supplies derive DC operating voltages for critical circuits, such as the main oscillators and phase lock circuits, from the output DC of the main power supply.

4-5. The microprocessor communicates with the internal circuits through a data bus, and an I/O printed circuit board. Command information is entered into the microprocessor through the front panel keyboard or an IEEE-488 interface. A key on the keyboard enables a front panel knob to permit knob adjustment of the output frequency and other parameters.

DIP switches are provided for option/test switch selections and an auxiliary connector is provided for auxiliary interface devices.

Input data selection is displayed by means of a digital readout and LED indicators.

The microprocessor stores and processes the input data, and generates data and address information to cause execution of commanded functions.

4-6. Seven main oscillators are used in the instrument to cover a basic frequency range of 135 to 269.999 MHz and all output frequencies are derived from the main oscillator output frequencies through division, or a heterodyne process.

The microprocessor supplies output frequency selection data to FM printed circuit board A3 where the data is decoded to cause selection of the correct oscillator for the selected output frequency data to the phase lock and pretune circuits and the data is converted into a control voltage that pretunes the selected main oscillator.

The output frequency of the main oscillator is then phase or frequency locked to an oven stabilized, crystal controlled reference oscillator to ensure output frequency stability and accuracy. An external reference source may also be used for phase lock.

The reference oscillator and divider circuits also supply a 10 MHz reference signal that is used for heterodyning on the lowest frequency band of instrument. With this arrangement, the frequency accuracy of the instrument is the same as that of the oven stabilized reference oscillator or the external reference source.

4-7. The main oscillator output frequency is supplied to frequency processor circuits for conversion to the final output frequency. Controlled by data supplied by the microprocessor, the frequency processor circuits can provide any of the following functions: Division by 1 (no frequency conversion), division by 2, 4, 8, 16, 32, and 64, and division by 16 combined with heterodyning with a 10 MHz reference signal.

4-8. Above 2.1 MHz, the AM (modulation) and leveling circuits use a PIN diode modulator to perform the dual functions of automatic leveling and amplitude modulation. Below 2.1 MHz, a 2 quadrant multiplier (integrated circuit A2A1OU22) is used.

The output level of the output RF amplifier is sampled by a diode detector and a control voltage is fed back to the appropriate modulator for automatic leveling of the output signal amplitude of the RF amplifier. The leveling loop minimizes variations in output signal amplitude over the entire operating range. The RF output signal from the modulators passes through low-pass filters that suppress harmonics and spurious frequencies generated as a result of frequency conversion, providing excellent spectral purity of the output signals.

PIN diodes are used to switch the RF path to the proper modulator and low

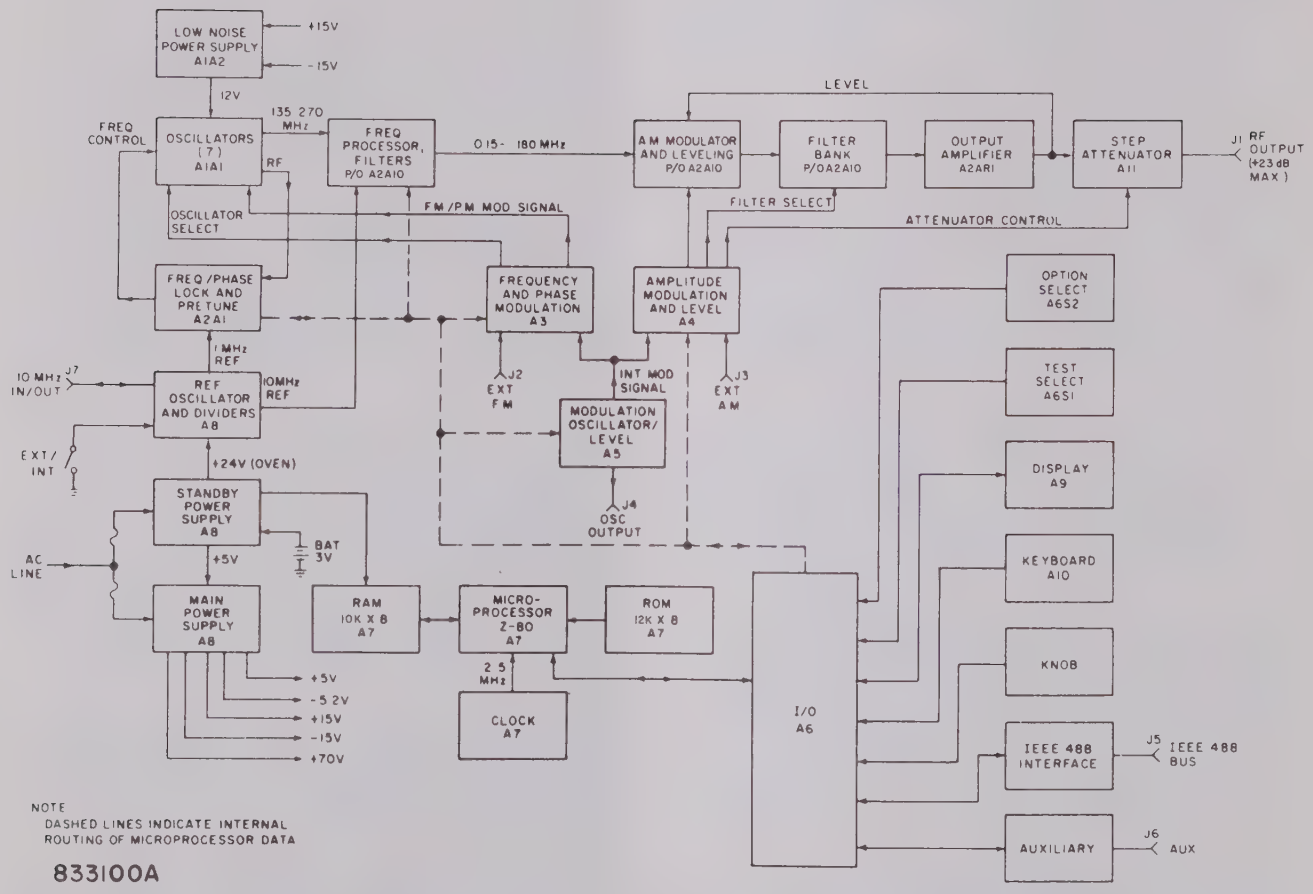

Figure 4-1. Simplified Block Diagram

pass filter for a particular frequency range. Selection of the proper path is accomplished by decoding data supplied from the microprocessor through latches on the AM channel circuit board.

4-9. The filtered RF signal is amplified by wide band RF amplifier and the amplified and leveled RF signal is then applied to a precision step attenuator.

Data that specifies output level selection is supplied to the amplitude modulation and level circuits by the microprocessor and this data activates relays of the attenuator to provide the selected output level.

4-10. Audio voltages used for AM, FM, and PM applications or a ramp voltage used for frequency sweep operation are generated by an internal modulation oscillator. The modulation oscillator uses a state variable oscillator circuit with automatic leveling. Its output frequency is programmable over a range of 20 Hz to 50 kHz. It supplies a constant 1 volt level for the internal modulation circuits, and a programmable level of 0 to 4.095 volts to a front panel connector for application to external equipment.

The 1 volt level is supplied to both the AM channel printed circuit board and the FM channel printed circuit board circuits. Output frequency and level signal supplied to the external equipment is controlled by data supplied from the microprocessor.

4-11. The AM channel printed circuit board contains amplifier and attenuator circuits that provide precise control of the percentage of modulation. Input modulating signals are supplied from the internal modulation oscillator or from an external source.

For accurate programming of the percentage of modulation, the audio signal amplitude from the external source must be 1 volt rms (2.828 volts peak to peak). Selection of the modulating signal source and the modulating signal level (percentage of modulation) is under control of the microprocessor.

Processed modulation signals are supplied to the diode modulator in the AM modulator and leveling circuit to produce amplitude modulation of the RF output signal.

4-12. Frequency modulation, phase modulation, and frequency sweep operation are achieved by tuning the main oscillator electronically by means of a varactor diode.

Modulating signals are provided by the FM channel printed circuit board, which can accept input signals from either the internal modulation oscillator or an external modulation source. The amplitude of the modulating signal is adjusted automatically by the microprocessor in accordance with the selected deviation, and the output modulating signal is supplied to the varactor diode in the main oscillator to cause frequency modulation, phase modulation, or frequency sweeping of the main oscillator output RF signal.

4-13. DETAILED CIRCUIT DESCRIPTIONS.

4-14. Microprocessor Circuits. Refer to Figure 4-2. The microprocessor circuits are the central control circuits of the instrument. They receive input commands and data from the front panel keyboard or an IEEE-488 interface and configure the internal circuits of the instrument in accordance with the input commands and data.

Storage facilities for up to 250 complete instrument setups are also provided. Operation of the microprocessor circuits is controlled by a fixed program resident in ROM and executed by the central processing unit (CPU).

4-15. The CPU is a single chip unit which accesses program instructions resident in ROM and executes the instructions. Timing of operations is established by a 2.5 MHz crystal oscillator that employs integrated circuit A7U2 and crystal A7Y1. Data interchanges with memory and I/O circuits are transacted over an 8 bit bidirectional bus. A 16-bit address bus provides addressing for memory and I/O circuit data exchanges.

System output signals consist of: signal $\overline{\text{MREQ}}$, which indicates that the address bus holds a valid address for memory read or write operation; signal $\overline{\text{IORQ}}$, which indicates that the address bus holds a valid address for an I/O read or write operation; signal $\overline{\text{WR}}$, which indicates that a write operation is to be performed; and signal $\overline{\text{RD}}$, which indicates that a read operation is to be performed.

CPU control signals include: signal $\overline{\text{INT}}$, which interrupts program operation and signals the CPU that a special function (INIT, LOCAL, KNOB CW, or KNOB CCW) is being requested; signal RESET, which resets the CPU to the beginning of the program; signal $\overline{\text{NMI}}$, which interrupts the CPU when the voltage level is too low for reliable operation; and signal $\overline{\text{HALT}}$, which indicates that the CPU has halted execution of the program in response to $\overline{\text{NMI}}$.

4-16. System control signals are supplied to the I/O circuits and to other microprocessor circuits through buffer A7U4. Data transfer between the CPU and memory are carried out over a bidirectional data bus through bidirectional buffer A7U7. The direction of data flow is controlled by signal $\overline{\text{RD}}$.

To read data from memory, the CPU activates signals $\overline{MRQ}$ and $\overline{RD}$, thereby configuring buffer A7U7 to permit data flow from memory to the CPU. For write operation, signal $\overline{RD}$ is inactive, and buffer A7U7 transfers data from the CPU to memory.

4-17. Address information is supplied from the CPU to a 16 bit address bus through buffers A7U5 and A7U6. Address bits A0 through A11 from the address bus are used to access storage locations in ROM and bits A0 through A10 are used to access storage locations in RAM.

Memory selection is achieved through decoding of address bits A12 through A15 by decoder A7U8 and address bits A11 through A15 by decoder A7U13.

4-18. To fetch a program instruction from ROM, the CPU specifies the memory location by activating appropriate address bits A0 through A11. It specifies the ROM containing the desired instruction through address bits A12 through A15, and activates signals $\overline{MRQ}$ and $\overline{RD}$. Signal $\overline{MRQ}$ together with address A15, enables decoder A7U8, and the decoder decodes address bits A12, A13, and A14 to activate the enabling signal to the specified ROM. Signal $\overline{RD}$ enables the output of the ROM, and program information stored at the location specified by address bits A0 through A11 is written onto the data bus. Signal $\overline{RD}$ sets bidirectional buffer A7U7, and the data on the bus is transmitted to the CPU.

4-19. Non-volatile data storage is provided by RAMs A7U14, A7U16, A7U17, A7U19, and A7U20. Each RAM can handle 2K 8 bit words. To write data into non-volatile memory, the CPU places the data on the data bus, it specifies the RAM and storage location in that RAM by activating the appropriate address bits, and it activates signals $\overline{MRQ}$ and $\overline{WR}$. Address bits A14 and A15 enable decoder A7U13 and the decoder decodes address bits A11,A12, and A13 to activate one of its output lines.

The active output enables the addressed RAM through a section of switch A7U15 or A7U18. Address bits A0 through A10 access the desired location in the selected RAM and signal $\overline{WR}$ causes data on the data bus to be written into memory at this location.

To access data in non-volatile storage, a similar process is used, except that signal $\overline{WR}$ is inactive, and signal $\overline{RD}$ is activated by the CPU. The addressed RAM and the location in the RAM are accessed in the same manner, however, the data at the accessed location is placed on the data bus. Bidirectional buffer A7U7 is set for the read function by signal $\overline{RD}$, and the data placed onto the data bus is transmitted through the buffer to the CPU.

Multiply and divide arithmetic operations are performed at high speed by two specialized peripheral devices A7U22 and A7U23. These devices operate in byte serial mode to provide 32 bit results. From the CPU they appear as a memory location, which is decoded by decoder A7U13 and connected to the CE inputs through inverter A7U21b.

Internal timing for peripheral device A7U22 is provided by the 2.5 MHz clock signal from the 2.5 MHz oscillator circuit, and this device generates the SHIFT clock for device A7U23.

4-20. To ensure retention of data in the RAMs, the RAMs are powered continuously by DC from the standby power supply, which is energized when the instrument is connected to the AC line. If the DC from this source should become unavailable, either as a result of power supply failure or disconnection of the instrument from the AC line, a battery on the mother/power supply printed circuit board supplies +3 volts to the RAM circuits. The RAMs will retain data with power supply voltage down to 2 volts.

4-21. Circuits associated with the standby power supply protect the microprocessor circuits against erroneous data caused by low voltage. If the DC voltage from the main +5 volt power supply drops below a reliable level, signal $\overline{SNMI}$ is activated by integrated circuit A8U8 and related components, thereby interrupting CPU operation and causing the RAM enabling signal supplied to switches A7U15a through A7U15d and A7U18a to be set low through gates A7U1a and A7U1b, thereby preventing RAM selection.

Signal $\overline{HALT}$ is activated by the CPU when program execution stops. Signal PRST is also set low when the power supply voltage fails, causing the CPU to be reset to the program start.

When proper DC voltage is restored, signal $\overline{SNMI}$ becomes inactive, thereby releasing the CPU interrupt and activating signal RAMEN through gates A7U1a and A7U1b. Signal PRST is set high, causing reset of the CPU, and the CPU resumes operation from the start of the program. Resistor A7R5 and capacitor A7C3 provide an automatic CPU reset on instrument power turn ON; the $\overline{RESET}$ input to the CPU is held low momentarily after power application until the capacitor can charge through the resistor.

4-22. Signal $\overline{INT}$ is activated by circuits on the display printed circuit board when certain data (INIT, LOCAL, KNOB CW, OR KNOB CCW) is being entered into the instrument. This signal indicates to the CPU that special data processing is needed. The CPU defers execution of the main program long enough to accept the new input data and process it before resuming execution.

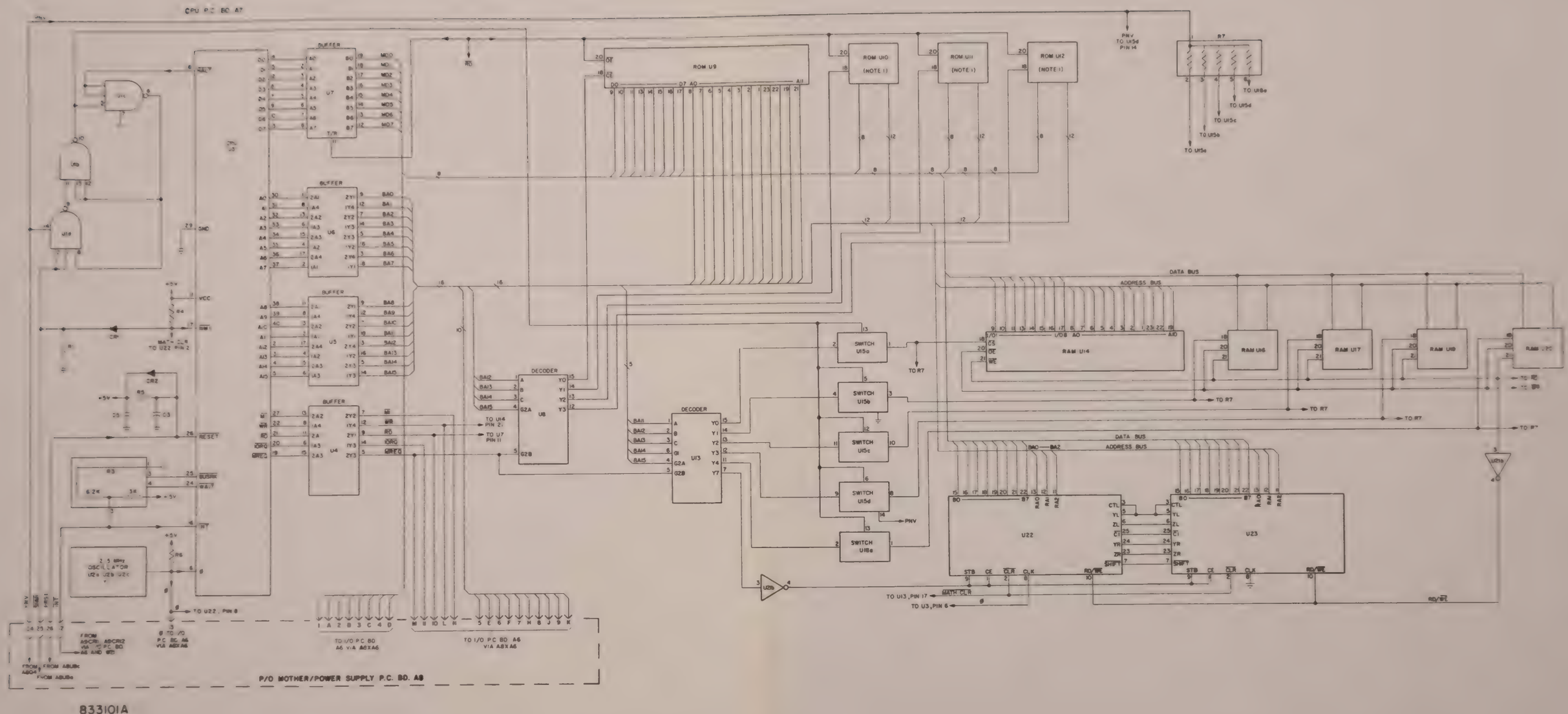

Figure 4-2. Microprocessor Circuits, Detailed Block Diagram

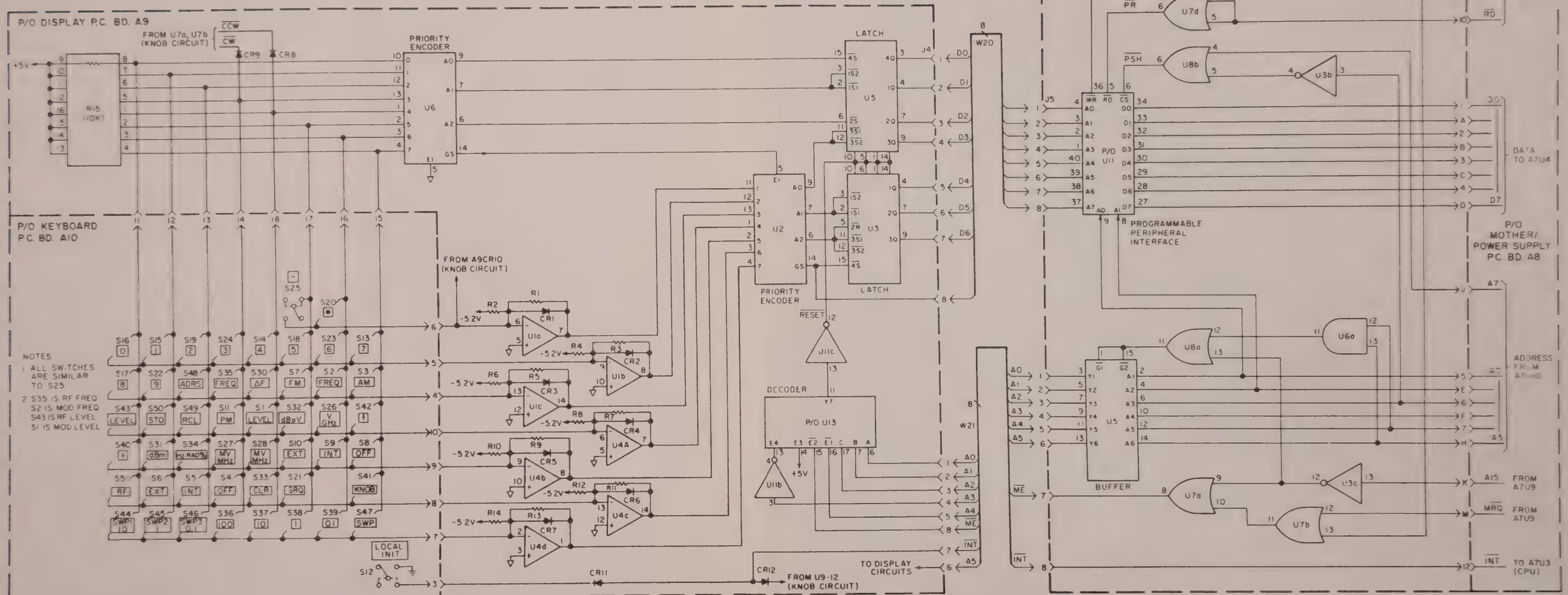

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Figure 4-3. Keyboard Key Circuits, Detailed Block Diagram

4-23. Keyboard Key Circuits. Refer to Figure 4-3. The keyboard key circuits translate key selection into digital data for transmission to the microprocessor circuits. Data transfers between the keyboard key circuits and the microprocessor circuits is handled through display printed circuit board A9, I/O printed circuit board A6, and the data bus.

4-24. The front panel keys are arranged electrically in a matrix of seven rows and seven columns. With all switches inactive, all row inputs to encoder A9U2 are set to a logic high level by operational amplifiers A9U1a through A9U1c and A9U4a through A9U4d.

All column inputs to encoder A9U6 are also set to a high logic level through resistance network A9R15. When a key is pressed, an electrical connection is established between one row line and one column line in the matrix, causing the corresponding row input line to encoder A9U2 and the corresponding column input line to encoder A9U6 to be set low.

For example: if switch A9S25 is pressed, a positive current is supplied to the input of operational amplifier A9U1a, causing its output, which is connected to input 1 of encoder A9U2, to switch to a logic low; input 5 to encoder A9U6 is simultaneously pulled to a logic low level. Encoder A9U6 sets its output lines to the binary equivalent of decimal 5. When any of its input lines is set low, encoder A9U6 also enables encoder A9U2 through its GS output, and this encoder sets its output lines to the binary equivalent of decimal 1. The GS output of encoder A9U2 is sensed by the CPU to determine whether any keys are being held down.

4-25. Output data from encoders A9U6 and A9U2 is loaded into latches A9U5 and A9U3, respectively, and is supplied along with the GS output of encoder A9U2 to port A of programmable peripheral interface A6U11. The CPU scans the I/O circuits periodically. When this data source is addressed by the CPU, interface A6U11 is enabled through gate A6U8b and inverter A6U3b, and port A of the interface is selected by decoding address inputs A0 and A1.

Signals $\overline{RD}$ and $\overline{IORQ}$ are also activated by the CPU to cause the interface to perform a read function on data at its A port. The data is transmitted from interface A6U11 to the microprocessor circuits.

When the CPU has read the data, latches A9U5 and A9U3 are reset through inverter A9U11c and decoder A9U13 by address information and signal $\overline{ME}$ controlled by the CPU. Note that the latches are reset to hex 20, not zero, and that the number keys are encoded with their ASCII equivalents.

For example: key 1, hex 31; key 2, hex 32, etc. Address information is supplied to decoder A9U13, through buffer A6U5, which is enabled through gates A6U8a and A6U6a when it is addressed by the CPU. Signal $\overline{ME}$ is activated through gates A6U7a and A6U7b when signals A15, $\overline{MRQ}$, and $\overline{WR}$ are activated by the CPU.

4-26. The keyboard key circuits also receive an input from the front panel knob circuit when the knob is turned. Knob input signals are supplied through diode A9CR9 or A9CR8 directly to encoder A9U6, and through diode A9CR10 to row operational amplifier A9U1a. The level applied through diode A9CR9 or A9CR8 indicates the direction in which the knob is being turned. The knob signal is encoded in the same manner as a key signal. In addition, an $\overline{INT}$ signal is supplied to the CPU from the knob circuits to interrupt program execution for each increment of rotation (100 increments/revolution).

4-27. Knob Circuits. Refer to Figure 4-4. The knob circuits provide means for manually stepping a preselected instrument function value in preselected steps using the front panel knob. The CPU executes knob commands only if the key entered KNOB function has been selected. Knob data is supplied to the keyboard key circuits, where it is encoded in the same manner as key data for transmission to the CPU.

4-28. The front panel knob is coupled mechanically to an optoelectronic rotation encoder with 100 steps per revolution. The encoder is powered by +5 volts from display printed circuit board A9. As the knob is turned, the encoder generates two pulse trains, designated A and B in Figure 4-4. The relative phase of the two pulse trains depends on the direction of rotation of the knob, and frequency of the pulses is proportional to the speed of knob rotation.

4-29. Assume that the knob is being turned in the direction that causes signal A to lead signal B. During the low level interval of signal A, the D input of flip-flop A9U8 is set high through gate A9U7c. When the negative transition of signal B occurs, the positive transition output of gate A9U7d clocks flip-flop A9U8 and multivibrator A9U9a. Because its D input is set high, the $\overline{Q}$ output of flip-flop A9U8 is set high and the Q output is set low when the flip-flop is clocked.

Multivibrator A9U9a introduces a time delay of approximately 1 microsecond. At the end of this period, the negative transition in the output of the multivibrator triggers multivibrator A9U9b, and this multivibrator developes a high level pulse at its Q output and a low level pulse at its $\overline{Q}$ output. The low level pulse activates signal $\overline{INT}$ through

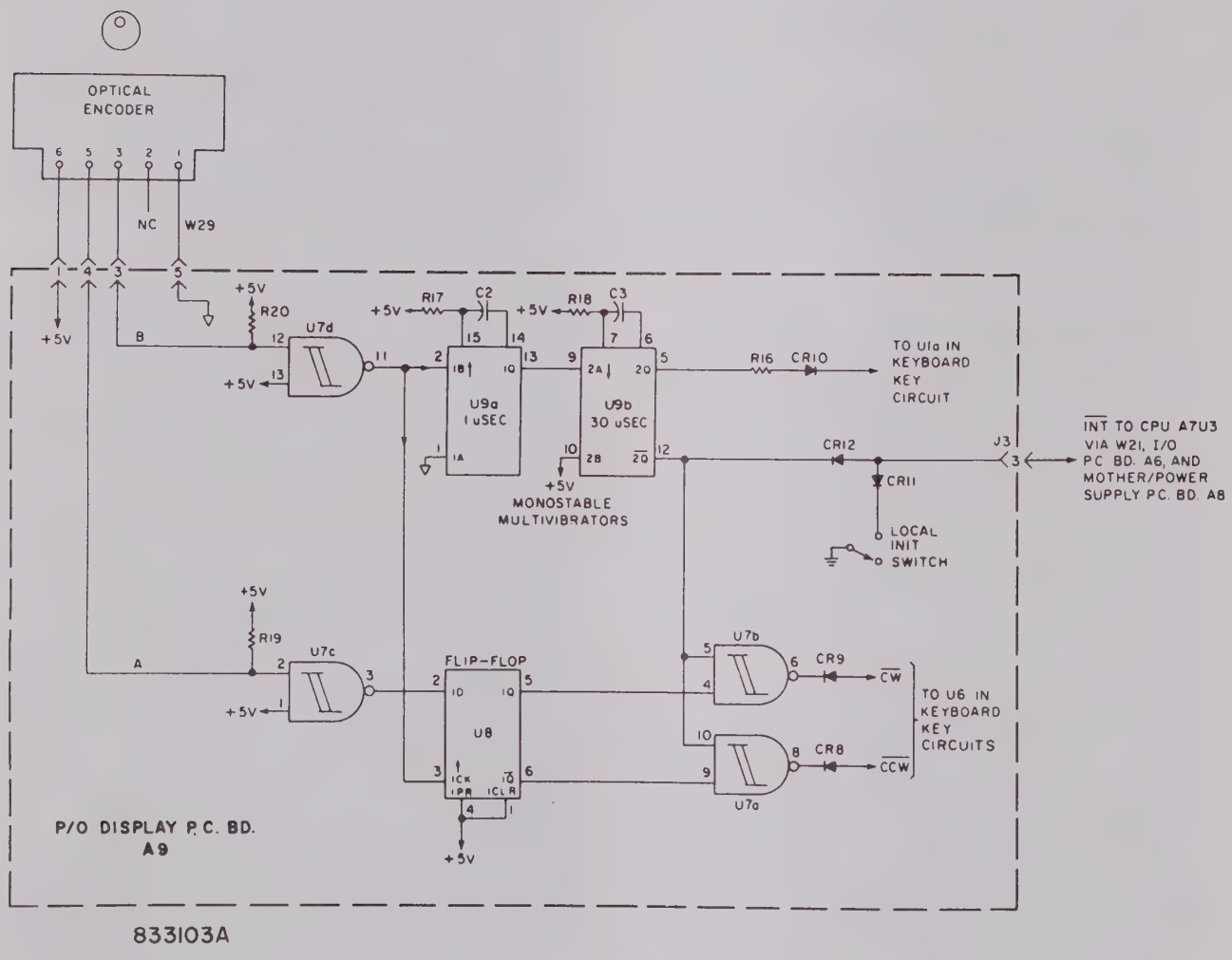

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Figure 4-4. Knob Circuits, Detailed Block Diagram

doide A9CR12 thereby interrupting the CPU and causing the CPU to check for knob data.

The high level output pulse of multivibrator A9U9b activates the row 1 signal to the keyboard key circuits through diode A9CR10 and sets the column 3 signal of the keyboard key circuits low through gate A9U7b and diode A9CR9.

The row 1 column 3 combination is translated into digital data that specifies to the CPU the direction in which the knob is being turned. If the knob is turned in the opposite direction, signal A from the encoder lags signal B. The D input of flip-flop A9U8 is then low when the flip-flop is clocked through gate A9U7d, and the output level of the flip-flop are reversed.

The column 4 signal to the keyboard key circuits is activated through gate A9U7a and diode A9CR8. The $\overline{\text{INT}}$ and row 1 signal remain as before. The row 1 column 4 combination is translated into digital data and transmitted to the CPU, indicating to the CPU that the knob is being turned in the opposite direction.

A subroutine is executed by the CPU whereby the preselected function value is changed in a direction determined by the direction of knob rotation and an amount equal to the total number of increments counted, multiplied by the step size.

4-30. IEEE 488 Interface Circuits. Refer to Figure 4-5. The IEEE-488 interface circuits provide means for remote control operations. Connection to the IEEE-488 interface bus is made through connector J5 on the rear panel of the instrument.

The IEEE-488 interface circuits convert IEEE-488 bus compatible signals into control codes for the instrument and convert instrument data into IEEE-488 bus compatible signals for use on the bus.

All data transfers are handled by source and acceptor handshake protocol as defined by IEEE-488. The instrument address for IEEE-488 interface operation is preset through the front panel keyboard. Status is indicated by LED indicators in the display circuits.

4-31. All input and output data is controlled by programmable peripheral interface A6U12. Selection of the interface and control of the direction of data flow is exercised by the CPU.

Interface selection is made by activating signal $\overline{\text{PSL}}$ through gate A6U8c by address bits A2 and A7. For transfers of data from the IEEE-488 bus to the CPU, signal $\overline{\text{PR}}$ is activated by signals $\overline{\text{IORQ}}$ and $\overline{\text{RD}}$ from the CPU; for data transfer in the opposite direction, signal $\overline{\text{PW}}$ is activated by signals $\overline{\text{IORQ}}$ and $\overline{\text{WR}}$ from the CPU.

4-32. Programmable peripheral interface A6U12 consists of an 8-line bidirectional data bus (port D) which can be switched internally to any of three ports. Switching is controlled by its address A0 and A1 from the CPU. Port A of the interface is used for data in/out, port B is used for certain test function, and port C is used for handshake controlling. Interface handshake terminology is as follows:

Signal	Definition	Use
DAV	Data valid	--- Data transfer handshake
NRFD	Not ready for data	
NDAC	Not data accepted	
ATN	Attention	Bus commands
IFC	Interface clear	Clears interface (untalk/unlisten)
REN	Remote enable	Enable remote mode
SRQ	Service request	Request service (serial poll)
EOI	End or identify	Indicates last data byte of message

When power to the instrument is turned on, the software causes signals TALK and LISTEN to be set low. When the external peripheral device is set to send commands, signal ATN is activated, thereby resetting flip-flop A6U19b and activating signal LISTEN through gate A6U14d.

Bus transceivers A6U18 and A6U17 are conditioned to transfer data from the IEEE-488 data bus to port A of interface A6U12 for transmission to the CPU. Signal LISTEN releases gates A6U16b and A6U16b to permit transmission of an NRFD or NDAC signal by the microprocessor circuits when applicable.

4-33. When the instrument is set to transmit data to the IEEE 488 interface bus, a clock pulse is supplied to flip-flop A6U19a through interface A6U12 and the flip-flop changes its output states, thereby activating signal TALK through gate A6U14c. Signal TALK conditions bus transceivers 6U18 and A6U17 for data flow in the opposite direction, and instrument data is transmitted through port A of interface A6U12 and bus transceivers to the interface bus. Signal TALK also releases gate A6U15c for receipt of an NRFD signal from the external peripheral device, if applicable, and releases gate A6U16a to permit transmission of a DAV signal to the external device.

4-34. If the external peripheral device should activate signal ATN during data transfer to the interface bus, flip-flop A6U19a is cleared through gate A6U14a and inverter A6U13b or A6U13d. When the flip-flop is cleared, signal TALK is set low and signal LISTEN is activated. Remote control can be terminated at the instrument by pressing the front panel LOCAL INIT key (if local lockout is not active).

4-35. Port B of inteface A6U12 is used to transmit switch activated test data to the CPU. Segments of switch S1, when closed, cycle various portions of the instrument circuitry for testing. Port B is also used to transmit phase lock status signals from the phase lock circuits and signal REN from the external peripheral device to the CPU.

4-36. Display Circuits. Refer to Figure 4-6. The display circuits provide an unambiguous display of key selected or IEEE-488 interface selected data and interface status across the top section of the instrument front panel. Three groups of alphanumeric LED displays and four groups of LED indicators are used for this purpose. Control of the displays is exercised by the CPU through I/O printed circuit board A6.

4-37. When data is to be transmitted to the display circuits, data is supplied to buffer A6U10 and address information is supplied to buffer A6U5 by the microprocessor circuits. The buffers are enabled by the microprocessor circuits through gates A6U6a and A6U8a and inverter A6U3c.

Data is transmitted from buffer A6U10 to the data bus in the display circuits, and address information is transmitted from buffer A6U5 to address decoders in the display circuits.

Data on the display circuit data bus is available to latches A9U17 through A9U37. When any latch is clocked, the data bus at that time is loaded into the latch. Enabling of the latch is achieved through a decoding of the address information supplied from buffer A6U5.

4-38. The alphanumeric display uses seven-segment LED display elements, one for each digit of the display. All are similar, therefore, only the circuits for digit display A9DS1 are shown in detail in Figure 4-6. Digit display A9DS1 displays the most significant digit of modulation values (modulation frequency, modulation oscillator level, modulation deviation, cr modulation depth). It has eight inputs, one for each of the seven segments and one for the decimal point.

These input lines are activated through resistance network A9R22 by data loaded into latch A9U17. When the most significant digit of the modulation display is to be updated, latch A9U7 is enabled by decoded address information from decoder A9U10, and data on the data bus is loaded into latch A9U17. This data appears at the output of the latch, causing digit display A9DS1 to display the character specified by the data.

4-39. The remaining three digits of the modulation display, the eight digits of the output frequency display, and the five digits of the RF output level display all operate in a similar manner. Selection of the digit display that is to receive data is achieved through a decoding of address bits A0, and A1 and A2 by decoders A9U10, A9U12, and A9U13.

Selection of the appropriate decoder, in turn, is controlled by address bits A3, A4, and A5. When signal $\overline{\text{ME}}$ is activated through gates A6U7b and A6U72 and inverter A6U3c, one of the decoders, determined by the address is enabled. The enabled decoder decodes address bits A0, A1, and A2 to activate one of its output lines, thereby enabling the addressed data latch to latch data into that latch for display on the corresponding digit display.

4-40. A similar arrangement is used for the LED indicator groups of the display circuits. Four LED indicator groups are used to indicate measurement units and status. Individual LED indicators in each group are activated by microprocessor data supplied through a data latch and a resistance network.

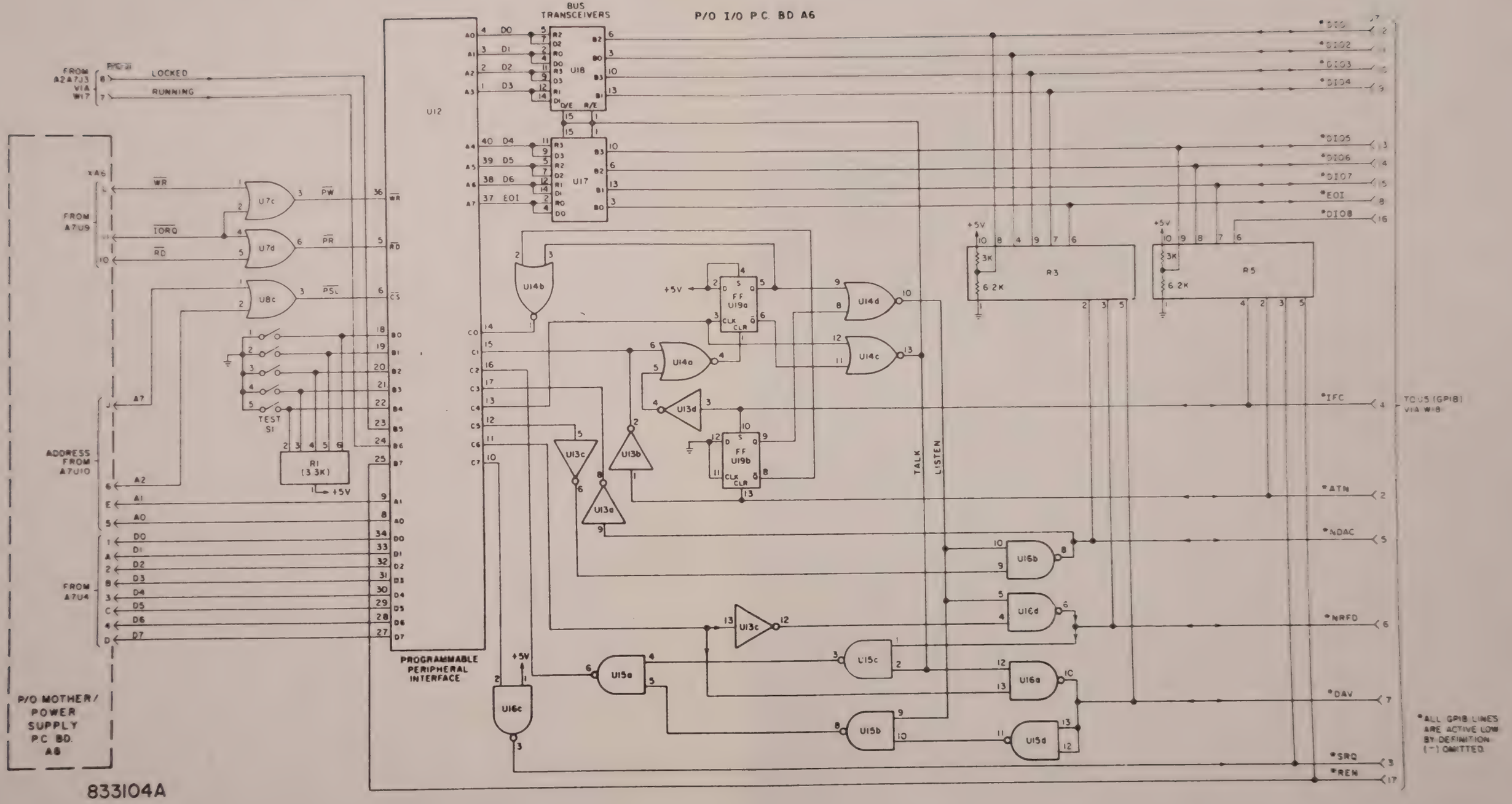

Figure 4-5. IEEE-488 Interface Circuits, Detailed Block Diagram

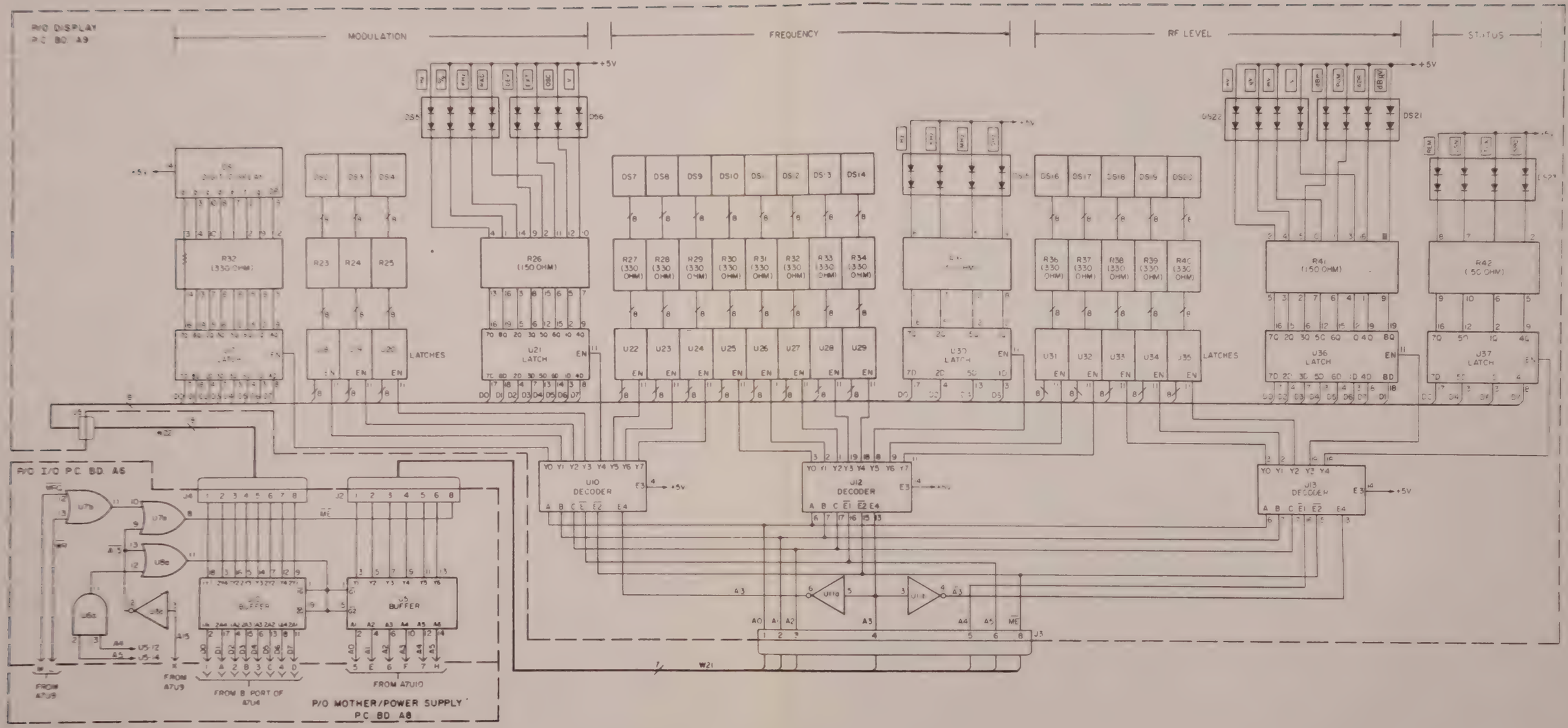

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Figure 4-6. Display Circuits, Detailed Block Diagram

Selection of LED indicator groups is controlled by enabling signals supplied to the corresponding latches from the address decoders; once a group has been selected, the individual LED indicators in that group are lighted in accordance with the data applied from the data latch.

4-41. Key Indicator Circuits. Refer to Figure 4-7. Some of the function keys on the instrument keyboard have integral indicators that are used to indicate key selection. These key indicators are lighted through the I/O printed circuit board by the microprocessor circuits after the corresponding keys have been pressed.

4-42. The key indicators are divided into two groups. One group, which contain LED indicators that may be lighted in various combinations, is controlled by data supplied through latch A9U14 and resistance network A9R21; the second group is controlled by data supplied through latch A9U15 and decoder A9U16.

Group selection is achieved by activating an enabling signal to the corresponding data latch. Enabling signals are developed by decoder A9U13 through a decoding of address bits A0, A1, and A2 when the decoder is enabled through address circuits on I/O printed circuit board A6.

4-43. When one of the function keys is pressed, key selection data is supplied to the microprocessor circuits by the keyboard key circuits. The microprocessor circuits supply key indicator control data to the key indicator circuits on the data bus, and address information for the LED indicator group that is to receive the data bus, and address information for the LED indicator group that is to receive the data on the address bus.

Data is supplied to the display data bus through buffer A6U10 and address information is supplied to the address bus through buffer A6U5 when the buffers are enabled through gates A6U6a and A6U8a and inverter A6U3c. Address information is decoded by decoder A9U13 when the decoder is enabled through gates A6U7b and A7U7a and inverter A6U3c, and the decoder decodes address bits A0, A1, and A2 data latch A9U14 or A9U15, as specified by the address. Data on the data bus is then loaded into the enabled latch.

The LED indicators in the first indicator group are lighted through resistance network A9R21 by low data bits stored in latch A9U14; thus any number of LED indicators in this group could be lighted simultaneously. Data loaded into latch A9U15 is decoded by decoder A9U16 to activate only one of the decoder output lines at a time, as specified by the data. The active decoder output line causes lighting of the corresponding key indicator in the second group.

4-44. Main Oscillator Circuits. Refer to Figure 4-8. The main oscillator circuits, which are housed in oscillator housing assembly A1, generate the basic RF from which all RF output frequencies are derived. Seven oscillators are used to cover a frequency range of 135 to 269.9999 MHz.

Selection of the appropriate oscillator is controlled automatically by the microprocessor circuits in accordance with the instrument output frequency selection. To enhance instrument accuracy and stability, the main oscillators are phase locked to an internal, oven stabilized, crystal controlled, 10 MHz reference oscillator, or to an external reference source.

Output RF from the main oscillator circuits is supplied to the frequency processor circuits for conversion to the final instrument output frequency and to the phase lock circuits for use in the frequency/phase lock process. The basic frequency ranges of the seven band oscillators are as follows:

Oscillator	Frequency Range
Band 0	135.0000 to 149.0499 MHz
Band 1	149.0500 to 164.5699 MHz
Band 2	164.5700 to 181.6999 MHz
Band 3	181.7000 to 200.6099 MHz
Band 4	200.6100 to 221.4899 MHz
Band 5	221.4900 to 244.5499 MHz
Band 6	244.5500 to 269.9999 MHz

4-45. Except for component values, all seven band oscillator circuits are similar; therefore, only the band 0 oscillator is shown in detail in Figure 4-8. Each oscillator is a Colpitts type oscillator that uses a quarter-wave stripline as the main tuning element. Tuning within the oscillator band is accomplished electronically by varactor diode A1A1CR01 under control of tuning signals from the phase lock circuits.

4-46. When an instrument output frequency selection that uses the band 0 oscillator is made, frequency selection data is supplied to the microprocessor circuits from either the instrument keyboard or the IEEE-488 interface.

The microprocessor circuits set data bits D0, D1, and D2 according to the band oscillator required for that output frequency. (For band 0, all three data bits are set low.) These data bits are supplied to latch A2U10 through buffer A6U9 when the buffer is enabled through

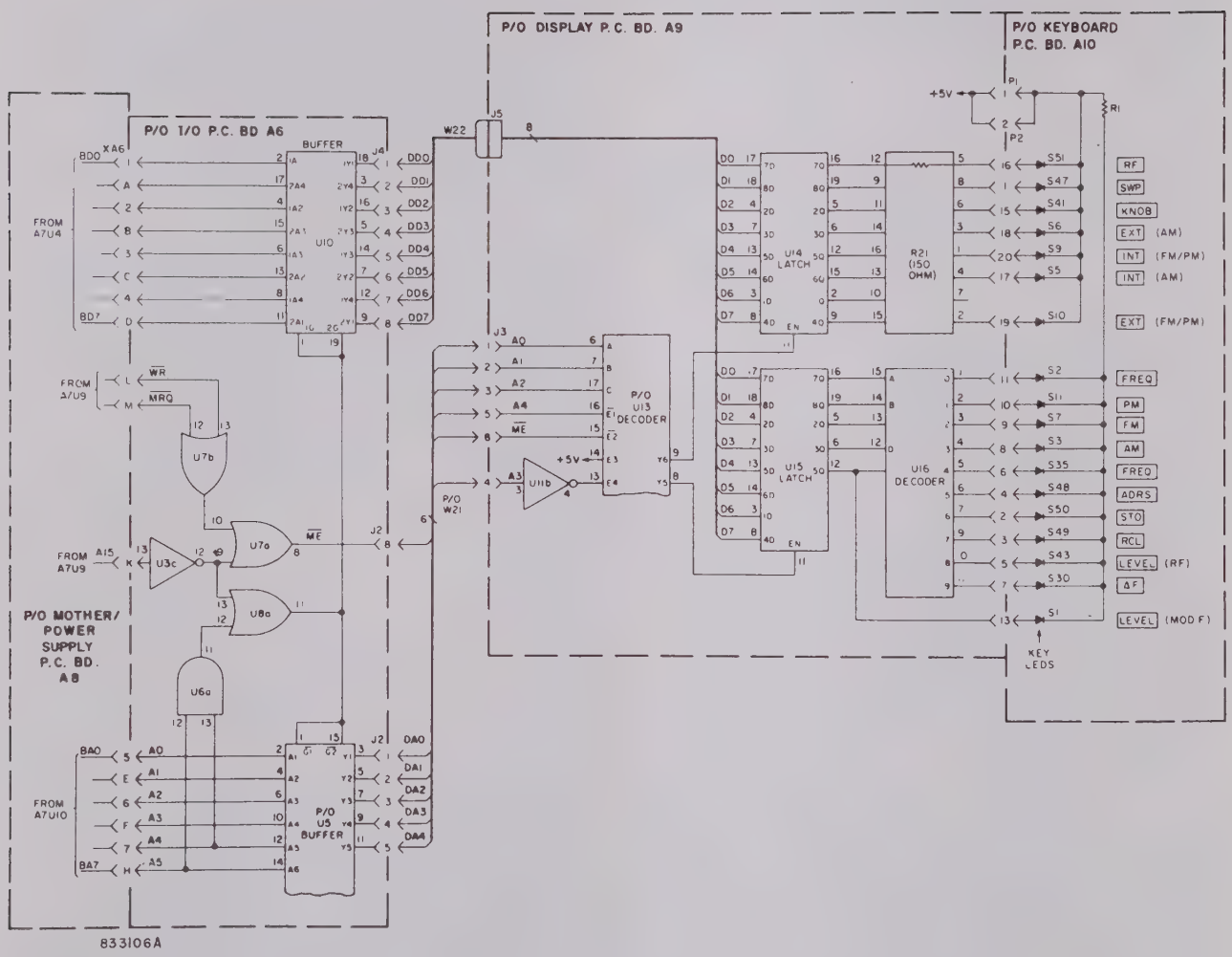

Figure 4-7. Key Indicator Circuits, Detailed Block Diagram

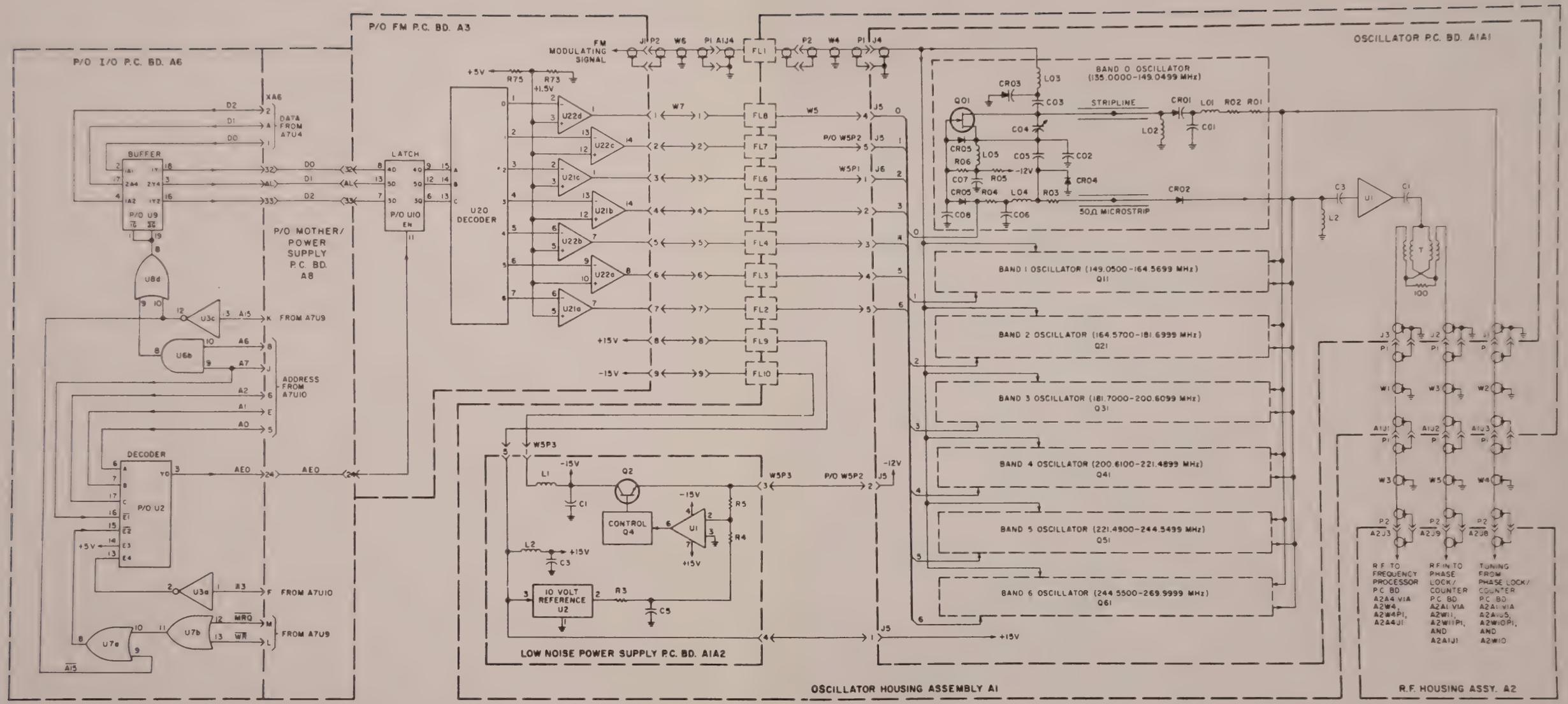

Figure 4-8. Main Oscillator Circuits, Detailed Block Diagram

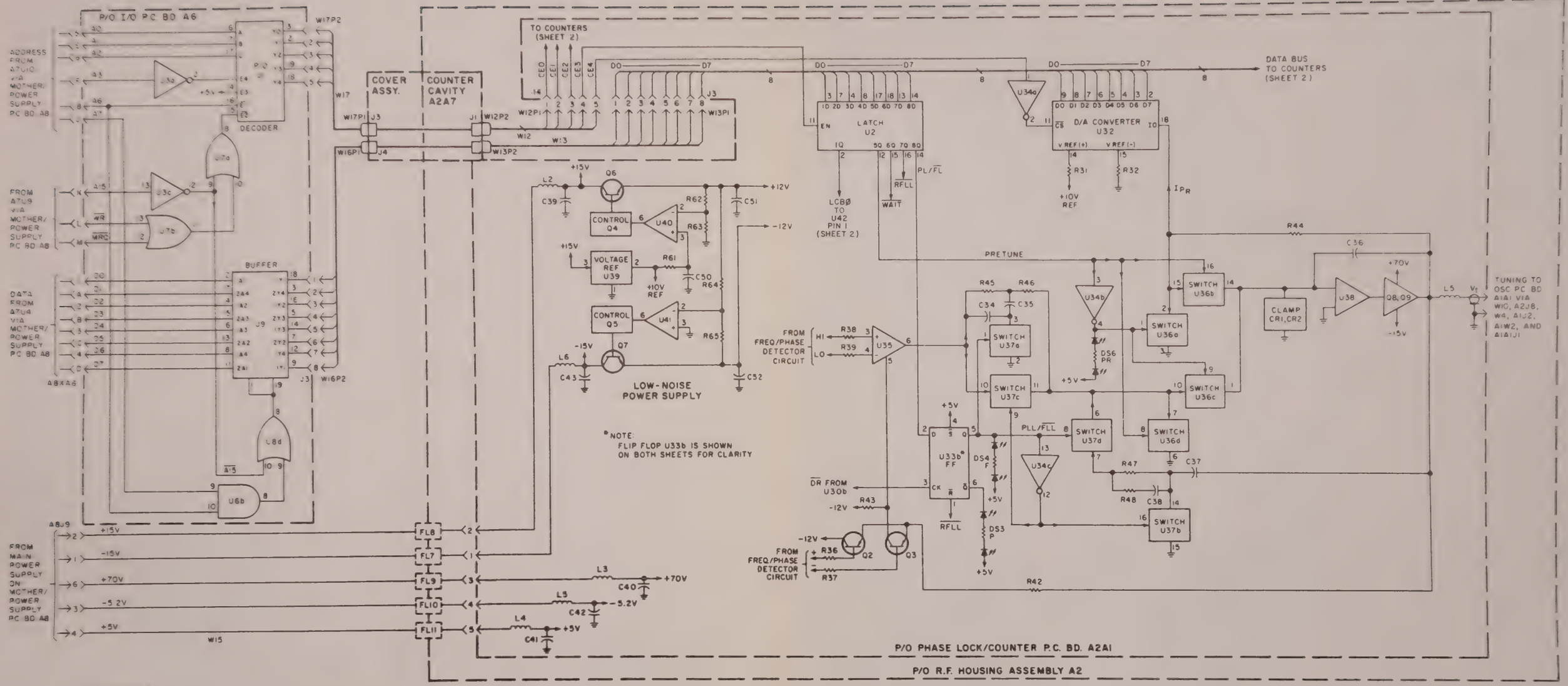

Figure 4-9. Phase Lock Circuits, Detailed Block Diagram (Sheet 2)

gates A6U6b and A6U8d and inverter A6U3c by the microprocessor circuits.

Address information specifying latch A3U10 as the data destination is supplied to decoder A6U2 by the microprocessor circuits, and the decoder is enabled through gates A6U7b and A6U7a and inverters A6U3a and A6U3c. Address bits A0, A1, and A2 are decoded by decoder A6U2 to develop the enabling signal for latch A3U10, thereby causing input data bits to be loaded into the latch.

Data bits D0, D1 and D2 stored in latch A3U10 are decoded by decoder A3U20 to set low the specified output line of the decoder. For band oscillator selection, the low output of decoder A3U10 is applied to bi-polar switch A3U22d, causing the output level of the switch to rise to approximately +13 volts. This level reverse biases diodes A1A1CR06 and A1A1CR04 to permit the band 0 oscillator to oscillate. A level of approximately -13 is applied to the corresponding diodes in the unselected oscillator circuits, and the diodes are forward biased to short out the other band oscillators and prevent their operation.

4-47. With diodes A1A1CR06 and A1A1CR04 reverse biased, the band 0 oscillator generates an RF signal within its operating band. It is pretuned to the proper point within the band by a tuning signal supplied to varactor diode A1A1CR01 from the phase lock circuits. The pretuning signal level is derived from microprocessor data that specifies instrument output frequency selection.

Diode A1A1CR05 limits the amplitude of the oscillator RF signal, and diode A1A1CR02 activates the RF output path. The RF signal generated by the oscillator is supplied through isolating amplifier A1A1U1 to the frequency processor circuits and to the phase lock circuits. It is compared in the phase lock circuits with the output of a temperature-stabilized, crystal-controlled reference oscillator or an external reference source, and the phase lock circuits supply a tuning signal to varactor diode A1A1CR01 to lock the oscillator to the reference source.

When frequency modulation, phase modulation, or frequency sweep operation is used, the modulating signal from FM printed circuit board A3 is supplied to varactor diode A1A1CR03 to modulate the oscillator. Phase lock operation is uneffected by modulation.

4-48. In order to limit noise and distortion, the oscillator is powered from low-noise power supply A1A2 in the oscillator housing assembly. Input voltages to the low-noise supply consist of regulated +15 volts and regulated -15 volts supplied through FM printed circuit board A3.

The regulated +15 volts powers 10 volt reference A1A2U2 to develop a stable DC reference voltage against which the output voltage of the low-noise power supply is compared. Regulated -15 volts is converted to regulated -12 volts by series regulator A1A2Q2 and associated circuits.

The regulated -12 volts is sampled by amplifier A1A2U1, and any variation in the regulated -12 volts output is compensated for by an error signal developed by amplifier A1A2U1 and supplied to series regulator A1A2Q2 through control transistor A1A2Q2. The regulated -12 volts from the low-noise supply powers the band oscillators on oscillator printed circuit board A1A1.

RF leakage is minimized by filters at the input of oscillator housing assembly A1.

4-49. Phase Lock Circuits. Refer to Figure 4-9. The phase lock circuits, under control of the miroprocessor, pretune the selected band oscillator in accordance with instrument output frequency selection, and then lock the band oscillator to a highly stable 10 MHz reference for superior output frequency accuracy and stability.

The 1 MHz reference signal is supplied through circuits on mother/power supply printed circuit board A8 from either an internal, temperature stabilized, crystal oscillator, or from an external reference source.

Control of band oscillator frequency is achieved by supplying a tuning signal to a varactor in the band oscillator tuning circuit. Phase lock/counter printed circuit board A2A1 also contains a low/noise power supply which developes +12 and -12 volt operating voltages for some of the phase lock circuits.

4-50. The low-noise power supply is powered by +15 and -15 volts DC supplied from the main power supply circuits. Filters A2FL7 and A2F11 minimize RF leakage from RF housing assembly A2.

The +15 volt input is converted to a regulated +12 volt output by series regulator A2A1Q6. Amplifier A2A1U40 compares the +12 volt output with a +10 volt reference derived from the +15 volt supply by voltage reference A2A1U39 and supplies corrective signals to series regulator A2A1Q6 through control transistor A2A1Q4 to maintain a constant output voltage.

A similar arrangement is used to derive the -12 volt output from the -15 volt supply. The main circuit difference is that the -12 volt output is referenced to the +12 volt supply at the input of amplifier A2A1U41.

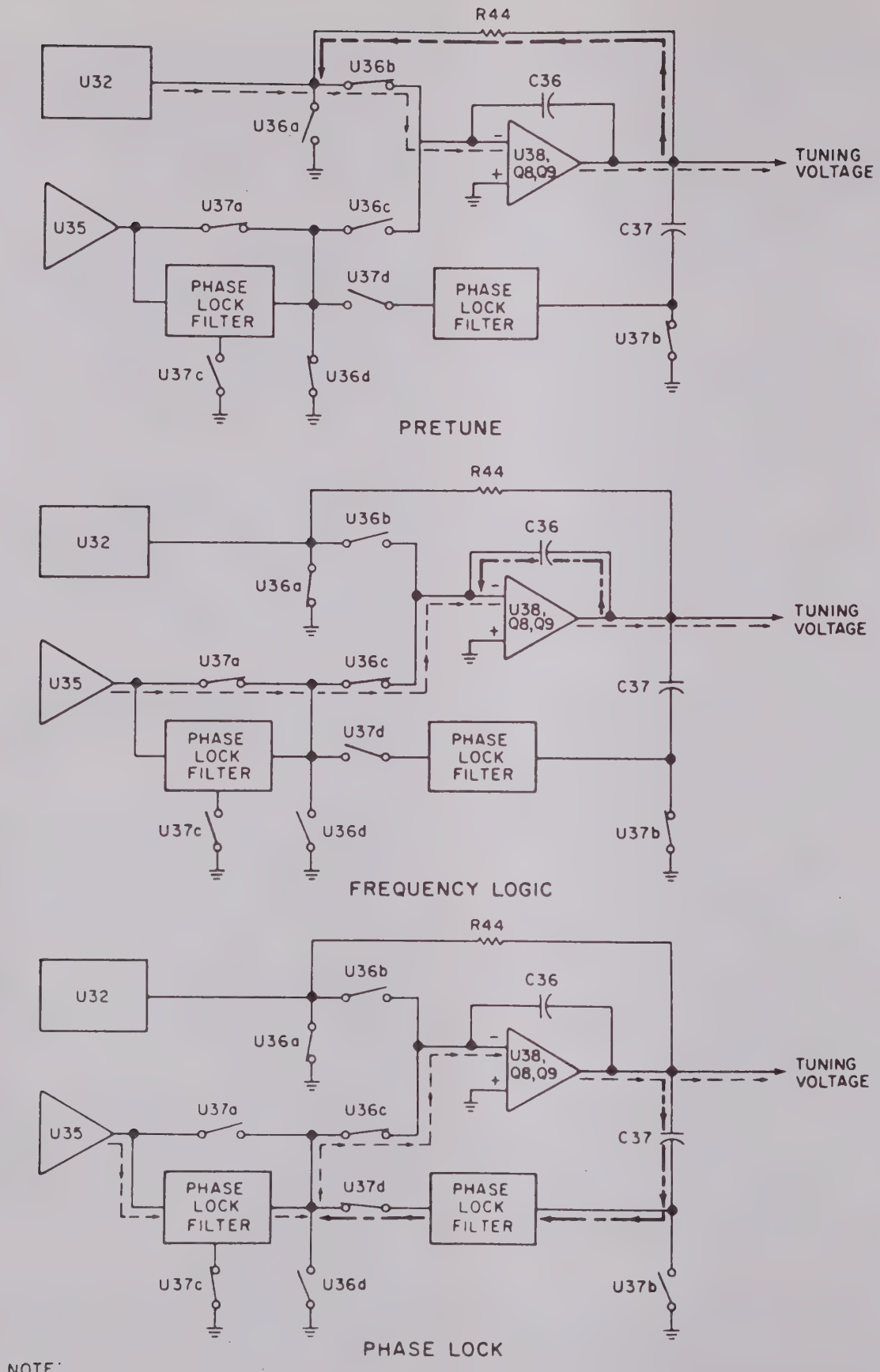

Figure 4-10. Phase Lock Integrator Switching, Simplified Functional Diagram

4-51. Changes in instrument output frequency are handled through the phase lock circuits by the microprocessor circuits in four major steps: wait, pretune, frequency lock, and phase lock.

Data required for these steps is supplied to the phase lock/counter printed circuit board from the microprocessor circuits through I/O printed circuit board A6. Data is supplied through buffer A6A9 when the buffer is addressed and the data is loaded into the correct circuit on the phase lock/counter printed circuit board through a decoding of address information by decoder A6U1.

Latch A2A1U2 stores data that specifies the step and the reference frequency division to be performed by the phase lock circuits. D/A converter A2A1U32 receives and latches data that specifies the point within its band to which the selected band oscillator is to be pretuned and latches A2A1U7, A2A1U14, and A2A1U22 store data that specifies the required operating frequency of the band oscillator for the selected instrument output frequency.

4-52. Signal $\overline{\text{WAIT}}$ is activated through latch A2A1U2 at the start of every output frequency change cycle. It resets frequency/phase detector flip-flop A2A1U13a and A2A1U30b through gate A2A1U4a, and inhibits operation of multivibrator A2A1U30b.

During the wait period, the correct band oscillator is selected by the microprocessor circuits and digital data that specifies the band oscillator frequency required to obtain the selected instrument output frequency is loaded into latches A2A1U7, and A2A1U14, and A2A1U22.

When signal $\overline{\text{WAIT}}$ is deactivated, multivibrator A2A1U30b is triggered, thereby activating signal $\overline{\text{DR}}$. In the frequency lock mode, multivibrator A2A1U30a is also triggered. Signal $\overline{\text{DR}}$ sets frequency/phase detector flip-flops A2A1U13a and A2A1U13b to initiate the frequency/phase detection process.

4-53. When signal PRETUNE is activated through latch A2A1U2, it turns on switches A2A1U36b and A2A1U36d and, through inverter A2A1U34b, it turns off switches A2A1U36a and A2A1U36c. Digital data that specifies the required operating point within the band of the selected band oscillator is supplied to D/A converter A2A1U32 at this time. The D/A converter converts the digital data into an analog current, and this current is converted into the band oscillator tuning signal by an integrator composed of operational amplifier A2A1U38 and transistor amplifier A2A1Q8/A2A1Q9.

Switch A2A1U36b passes the D/A converter signal to the integrator circuit, and switches A2A1U36c and A2A1U36d disable the output of the frequency/phase detector circuits.

The switching action for the three operating modes of the phase lock circuits is illustrated in Figure 4-10. The integrator circuit is protected against overload by clamp A2A1CR1/A2A1CR2. The selected band oscillator is pretuned to the approximate operating frequency by tuning signal from the integrator circuit.

When signal PRETUNE becomes inactive, the conditions of the switches are reversed and the integrator circuit then receives its input from the frequency/phase detector circuit instead of the D/A converter.

4-54. Frequency lock is initiated asynchronously by signal RFLL or synchronously by a low signal PL/$\overline{\text{FL}}$. Signal $\overline{\text{RFLL}}$ resets flip-flop A2A1U33a and A2A1U33b and multivibrators A2A1U28a and A2A1U28b. With flip-flop A2A1U33b resets, its Q output is set low. This low causes the four sections of switch loop characteristics in the integrator circuit for frequency lock operation and it enables multivibrator A2A1U30a to synchronize the gate and band oscillator frequency divider circuits.

Signal GR presets divider A2A1U31 which, together with dividers A2A1U43 and A2A1U44, divides the 1 MHz reference signal supplied from the reference circuits on mother/power supply board A8 down to either 80 Hz or 100 Hz for the lock loops. The LCB0 control line from latch A2A1U2 selects the frequency to be used through gate A2A1U42.

Signal GR also sets flip-flops A2A1U5a and A2A1U5b to cause presetting of band oscillator frequency divider A2A1U3 and presetting of down counter A2A1U9, A2A1U12, A2A1U16, A2A1U320, A2A1U24, and A2A1U27 to the count stored in the associated latches.

The down counters are clocked by divided output frequency of the band oscillator, and they count down from the initially loaded count. At the same time, dividers A2A1U43, A2A1U44, and A2A1U31 develop the gate signal. If the output frequency of the selected band oscillator is the same as the value entered into the latches, the down counters will count down to zero at the same time that the gate signal terminates, and frequency/phase detector flip-flop A2A1U13A and A2A1U13b are clocked simultaneously. With simultaneous clocking, signals HI and LO both remain at a logic low level, and no corrective signal is supplied to the integrator circuits.

Signals DOR and $\overline{\text{RST}}$ are also activated simultaneously. Signal DOR triggers multivibrator A2A1U28a and signal $\overline{\text{RST}}$ triggers multivibrator A2A1U30b to activate signal $\overline{\text{DR}}$ and start the next cycle.

When multivibrator A2A1U28a times out, it clocks flip-flop A2A1U33a, and the low $\overline{\text{DR}}$ signal at its data input is

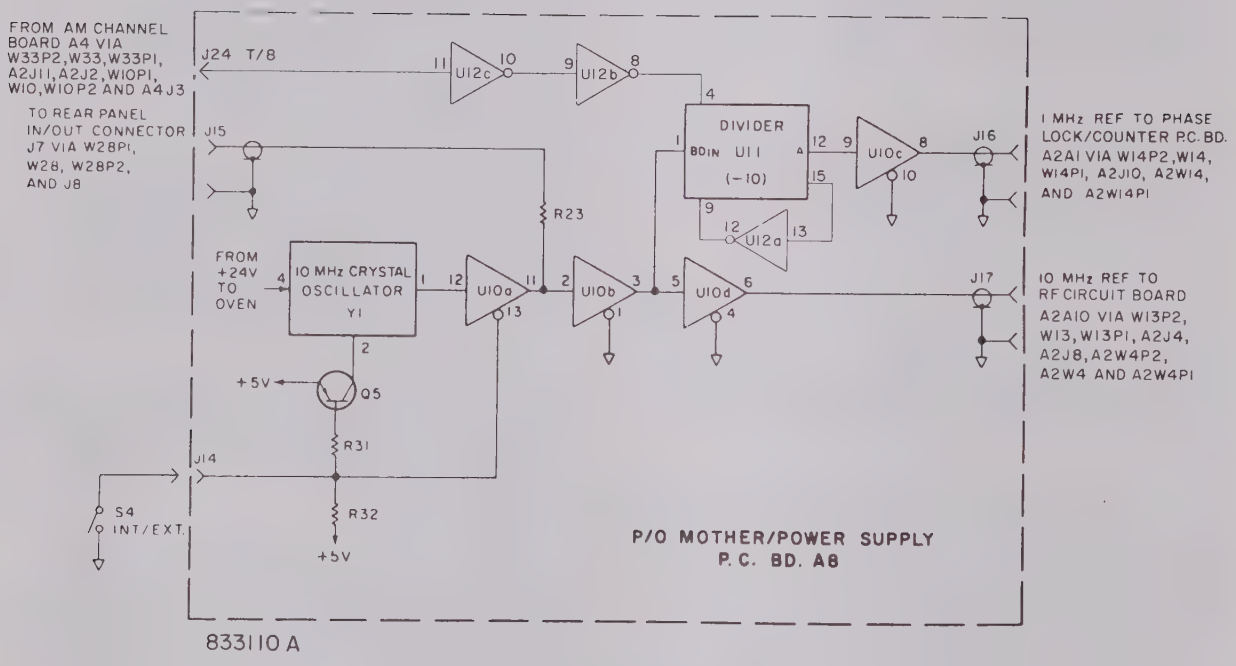

Figure 4-11. Reference Frequency Circuits, Detailed Block Diagram

clocked through the flip-flop activating signal LOCKED. This signal is supplied to the microprocessor circuits through I/O printed circuit board A6.

4-55. If the output frequency of the band oscillator is either higher or lower than the value entered into the latches by the microprocessor circuits, frequency/phase detector flip-flop A2A1U13a and A2A1U13b are not clocked simultaneously and a corrective signal is supplied to the integrator circuit to change the band oscillator turning signal in the proper direction to compensate for the frequency error.

For example: If the band oscillator frequency is too high, flip-flop A2A1U13a is clocked before the gate pulse termination clocks flip-flop A2A1U13b. In intervening period, flip-flop A2A1U13a activates the signal HI through gate A2A1U17a, and an error signal now appears at the input of amplifier A2A1U35.

Current switches A2A1Q3 and A2A1Q2 enable the amplifier, and the amplifier supplies a corrective current to the integrator circuit to adjust the tuning signal to the band oscillator. Signal $\overline{\text{DOR}}$ is activated when flip-flop A2A1U13a is clocked, but signal $\overline{\text{RST}}$ is not activated until flip-flop A2A1U13b is clocked.

If more than 100 nanoseconds elapse between signals DOR and $\overline{\text{RST}}$, signal $\overline{\text{DR}}$ is inactive when flip-flop A2A1U33a is clocked by multivibrator A2A1U28a, and signal LOCKED is inactive. Signal $\overline{\text{RST}}$ triggers multivibrator A2A1U30b to initiate another cycle of frequency lock operation, and this process continues until frequency lock is attained.

4-56. Reference Frequency Circuits. Refer to Figure 4-11. The reference frequency circuits on the mother/power supply printed circuit board A8 supply a highly stable reference signal to the frequency/phase lock circuit.

The main oscillator frequency and the heterodyne frequency used on the lowest frequency range of the instrument are locked to the reference frequency to ensure high accuracy and stability of the output frequency. The reference frequency can be derived from either an internal crystal oscillator or an external reference source. Selection of the reference frequency source is controlled by means of a rear panel switch.

4-57. When switch S4 is set to the INT position, 10 MHz crystal oscillator A8Y1 is used as the reference frequency source. The oscillator circuit is housed in a temperature stabilized oven for added stability.

The oven is powered by +24 volts supplied by the standby power supply. Because the oven is powered from the standby power supply, oven temperature is stabilized even during standby operation, thereby eliminating the need for lengthy warmup periods when the instrument is turned on.

4-58. Switch S4 turns on transistor switch A8Q5 to supply +5 volt operating power to the crystal oscillator circuit and enables buffer A8U10a to pass the 10 MHz reference signal generated by the crystal oscillator to following signal processing circuits.

The 10 MHz reference signal is supplied through buffers A8U10b and A8U10d to RF board A2A10 where it is used as the heterodyne frequency to develop the instrument output frequencies in the lowest output frequency band. It is also supplied through buffers A8U10b to divider A8U11, which divides the applied frequency by 10 to develop a 1 MHz reference signal for the frequency/phase lock circuits. This 1 MHz reference signal is supplied to phase lock/counter printed circuit board A2A1 through buffer A8U10c. A 10 MHz reference signal is also available at the rear panel IN/OUT connector J7 for use in synchronizing external equipment.

4-59. Frequency Processor Circuits. Refer to Figure 4-12. The frequency processor circuits on RF circuit board A2A10 convert the output frequency of the selected main oscillator to the commanded instrument output frequency through a process of frequency division or heterodyning.

Selection of the required process is controlled by data supplied from the microprocessor circuits through circuits on I/O printed circuit board A6 and AM channel printed circuit board A4. The RF output signals from the frequency processor circuits is supplied to the output circuits.

4-60. Input RF from the selected oscillator on printed circuit board A1A1 is buffered by amplifier A2A10U1 and sent through a divider chain or through a buffer gate to the output circuits. ECL gates and dividers are used to provide the proper RF switching and frequency division. The gates are controlled by signals generated from decoded data supplied by the microprocessor through latches on AM channel board A4. Decoder A2A10U7 provides the decoding function.

4-61. On the highest frequency band, no dividers are activated and signals from 135 MHz to 179.9999 MHz are gated directly to the output circuits through gates A2A10U3a and A2A10U3b. As lower frequencies are programmed, successively higher division ratios (2 to 64) are employed to drive lower octave bands from the basic 135 to 270 MHz range of the main oscillator circuits.

For output frequencies in the range of 67.5 MHz to 135 MHz, the signal is divided by 2 by divider A2A10U4, and is gated to the output circuits by gates A2A10U6a and A2A10U3b. The 33.75 MHz to 67.5 MHz range is generated by an additional division by 2 by divider A2A10U52 and the signal is gated to the output circuits through gates A2A10U8b, A2A10U6b, and A2A10U3b. Divided ranges are provided in a similar manner down to a 2.1 MHz to 4.2 MHz octave.

4-62. The lowest frequency range (0.15 MHz to 2.1 MHz) is generated by a heterodyne process. The 10 MHz reference source is used as the local oscillator and is beat against the 10.115 MHz to 12.1 MHz portion of the divide by 16 range to provide the appropriate output frequency.

Filtering is provided at both input signal ports and the output port of mixer A2A10Z1 to reduce the amplitude of spurious mixing products and harmonics. A PIN switch disconnects the 10 MHz reference from the mixer on all other ranges to prevent leakage into the higher frequency circuitry.

4-63. Output Circuits. Refer to Figure 4-13. The output circuits provide automatic leveling, wideband amplification, filtering, amplitude modulation, and output level adjustment capabilities for the RF signals supplied from the frequency processor circuits. Output RF signals are supplied to the front panel RF OUT connector.

4-64. Frequencies above 2.1 MHz are applied to transformer A2A10T1, which is the input transformer of a PIN diode modulator consisting of diodes A2A10CR29 through A2A10CR36. The modulator provides precise changes in attenuation for small programmed changes in the RF output level, for automatic leveling, and for amplitude modulation. The effective series resistance of the PIN diodes is determined by the control current supplied by AGC amplifiers A2A10U20 and A2A10U23. The attenuation of the modulator, in turn, varies in accordance with the diode series resistance.

4-65. For automatic leveling a DC feedback signal that is proportional to the level of the RF output signal from wideband amplifier A2AR1 is developed by diode detector A2A10CR40. This signal is supplied to one input of differential amplifier A2A10U23.

A DC level determined by the programmed instrument output level is applied to the second input from AM channel board A4. Whenever the RF amplifier output signal level corresponds to the level established by the DC level from the AM channel board, the feedback signal level is constant and the attenuation of the modulator provided to an RF signal does not change.

If the RF output level should tend to change, the feedback signal level changes accordingly and the control current to the modulator diodes varies in a manner to change their effective resistance in an inverse direction to compensate for the initial change in the RF output signal level. The leveling loop maintains the output level of the instrument constant within ±0.7dB (AT 0 dB output) over the entire frequency range.

4-66. Frequencies below 2.1 MHz supplied by the frequency processor circuits are amplified by RF amplifiers A2A10Q2 and A2A10Q3 and are applied to a different modulator circuit. It consists of integrated circuit A2A10U22, which is a two quadrant multiplier utilized as an amplitude modulator. It provides all the functions of the PIN diode modulator circuit utilized at the higher frequencies but with improved performance over the lower frequency range where PIN modulators tend to exhibit degraded performance. It is driven by AGC amplifiers A2A10U21 and A2A10U23. Amplifier A2A10U23, as before, receives one input from the diode detector through buffer A2A10U24 and the second input from AM channel board A4.

4-67. For AM operation, and AC signal from the AM channel board is superimposed on the DC level which determines the programmed RF output level of the instrument. The control signal applied to the AM modulator then has both an AC and DC component, and amplitude modulation is produced at the selected carrier output of wideband amplifier A2AR1 appears as a negative feedback signal to the loop, reducing some of the nonlinearity which would have occurred due to the modulator alone, especially at low modulating frequencies where maximum loop gain occurs.

An RC network is used to shape the frequency response for the loop encompassing each modulator (Resistor A2A10R89 and capacitor A2A10C127 for the high frequency leveling loop and resistor A2A10R88 and capacitor A2A10C128 for the low frequency leveling loop). These elements were chosen to optimize channel bandwidth consistent with maintenance of loop stability.

The AM bandwidth at carrier frequencies below 2.1 MHz is specified as 20 kHz; at carrier frequencies above 2.1 MHz is specified as 50 kHz.

The diode detector charging capacitor also effects loop response. In addition, it serves to provide adequate peak detection down to the lowest carrier frequency of interest to enable a satisfactory leveling characteristic. For this reason the capacitance is increased from 470 pF on ranges above 2.1 MHz to 31170 pF on the lowest frequency band. Relay A2A10K1 switches capacitor A2A10C149 into the circuit to effect this capacitance increase.

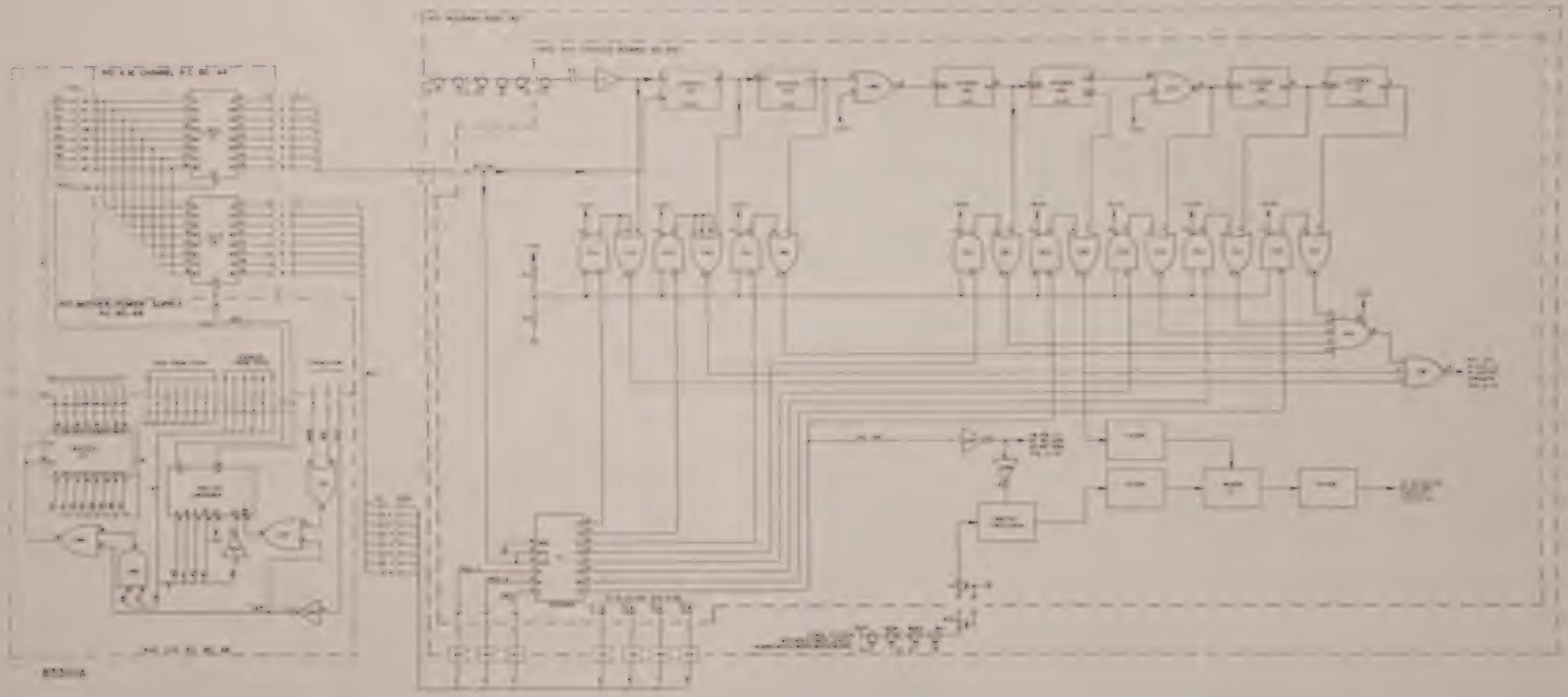

Figure 4-11. Frequency Processor Circuits, Detailed Block Diagram

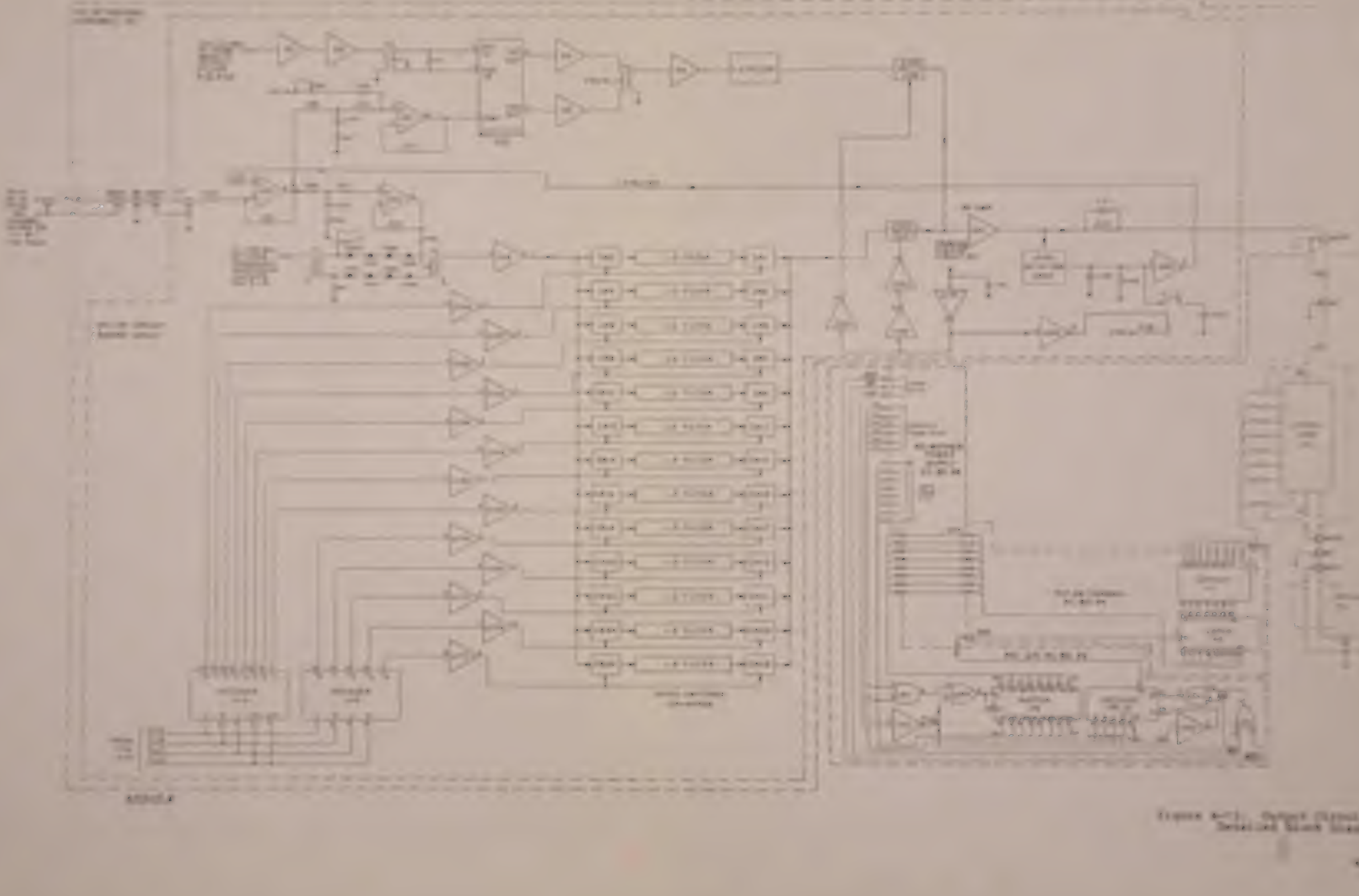

Figure 4-13. Channel Characteristics Detailed Block Diagram

4-68. The output signal from the PIN diode modulator used on all but the lowest frequency range of the instrument is applied to a bank of low-pass filters controlled by PIN diode switches. The switches serve to select the correct filter in response to drive signals derived from decoded data from the microprocessor.

The filters are required to reduce the harmonic content of the ECL derived carrier frequency to acceptable levels for signal generator applications. Two filters are used for each octave of the carrier frequency. A total of 13 filters are used since the top range (135-180 MHz) is less than half an octave.

The microprocessor supplied signals are decoded in decoders A2A10U14 and A2A10U16. Carrier frequency harmonics and out-of-band spurious mixing products for the lowest frequency band are suppressed by a low-pass filter at the output port of the mixer and an additional low-pass filter following RF amplifier A2A10Q6.

4-69. Wideband amplifier A2AR1 provides gain for RF signals over the entire frequency range of the instrument. PIN diode switches A2A10CR37 and A2A10CR38 select the proper input from the divider or heterodyne frequency processing circuits.

The amplified RF output signal is applied to diode detector A2A10CR40 and an output compensation network consisting of resistor A2A10R105 and capacitor A2A10C141. The detector develops a feedback signal proportional to the applied RF level. This is buffered by voltage follower A2A10U24, and is applied to the AGC amplifiers.

The output compensation network serves to improve the source impedance of the leveled output signal and to improve the output flatness by compensating for the frequency dependent insertion loss of the step attenuator which it drives.

The RF output of the instrument is adjusted automatically in response to microprocessor commands by the attenuator assembly in combination with the leveling circuits. Coarse adjustment in 4 dB steps is provided by the attenuator assembly, and fine adjustment (0.1 dB steps) is provided by the leveling circuits.

4-70. Attenuator assembly A11 is a relay-controlled, precision step attenuator. It provides 0 to 156 dB attenuation in 4 dB steps. Data supplied from the microprocessor circuits in accordance with output level selection controls the relays of the attenuator assembly to provide the required attenuation.

The RF output signal from the attenuator assembly is applied through RF fuse F3 to front panel RF OUT connector J1. Fuse F3 protects against damage that might be caused by excessive power from external source.

4-71. Control logic for the output circuits is contained on AM channel printed circuit board A4 and I/O printed circuit board A6. Data on the microprocessor data bus is transferred through buffer A6U9 to latch A4U2 when the buffer is addressed through gates A6U6b and A6U8d and inverter A6U3c by the microprocessor circuits.

Loading of data into the latch is controlled through a decoding of address bits A0, A1, and A2 by decoder A6U2 when the decoder is enabled through gates A6U7a and A6U7b and inverter A6U3a. When an enabling signal is applied to a latch, the data on the data bus at that time is loaded into the latch. Latch A4U2 stores data that specify the required output attenuation. Data stored in latch A4U2 activates the appropriate section so driver A4U1, and the output from the driver energizes the appropriate relays in attenuator assembly A11 to perform the switching necessary to introduce the attenuation required to provide the selected RF output level from the instrument. Attenuator pad values are 4, 8, 16, 32, 32, 32, and 32 dB; pad insertion is accomplished by the appropriate relays.

4-72. Modulation Oscillator Circuits. Refer to Figure 4-14. The modulation oscillator circuits generate sinusoidal AF signals or ramp voltages that can be used to modulate the RF output of the instrument. The tuning range of the sinusoidal AF circuits is 20 Hz to 50.00 kHz.

Output AF or ramp signals are applied to the front panel MOD OSC OUTPUT connector to drive external equipment. They are also applied to the AM channel and FM printed circuit boards. Function and frequency and amplitude selection are controlled by the microprocessor circuits in accordance with pushbutton selection.

4-73. Sinusoidal AF signals are generated by a statevariable oscillator circuit that utilizes operational amplifiers A5U1a, A5U1c, A5U1d, A5U4d, and A5U4b, D/A converters A5U2 and A5U7, and analog switch A5U6. A feedback loop from output to input sustains oscillation. The frequency of oscillation is determined by the time constant of coupling circuits.

D/A converters A5U2 and A5U7 process digital data from the microprocessor circuits to establish the required time constants for the selected frequency. Because of the relatively wide tuning

range, the frequency range is divided into four bands by analog switch A5U6 and related circuitry. This permits separate frequency calibration through potentiometer A5R12, A5R13, A5R14 and A5R52 for each band, thereby improving the frequency calibration over the entire operating range.

4-74. The output level of the state-variable oscillator signal is leveled automatically by a leveling loop. Voltage reference A5U5 develops a -10 volt reference from the -15 volt supply and this reference voltage is applied to a voltage divider consisting of resistors A5R16 and A5R10 and oscillator level adjust potentiometer A5R15.

A -3 volt output is also developed from the -10 volt reference for use by D/A converters A5U8 and A5U9. Potentiometer A5R15 provides means for adjusting the oscillator output level. The DC voltage from this potentiometer is applied to one input of operational amplifier A5U3a and it is compared against a DC level that is proportional to the amplitude of the oscillator output signal.

The difference is amplified by operational amplifier A5U3a and is applied through buffer A5Q1 to optical coupler A5DS1, which controls the feed back and thereby controls the oscillator output signal amplitude. The DC voltage that is proportional to the oscillator output signal amplitude is developed by average level detector A5U3b, which monitors the AF signal amplitude at the output of operational amplifier A5U1d.

If the AF signal amplitude should deviate from the set value, an error voltage is developed at the output of operational amplifier A5U3a and this error voltage changes the feed back through buffer A5Q1 and optical coupler A5DS1 to compensate for the change in AF signal amplitude. With this leveling arrangement, the output signal level of the modulation oscillator remains constant regardless of frequency.

4-75. Switch A5U6 effectively divides the oscillator tuning range into four bands: 20 Hz to 249 Hz, 250 Hz to 2499 Hz, 2.50 kHz to 25.00 kHz, and 25kHz to 50 kHz. Band selection is controlled by digital data bits D4 and D5 from the microprocessor circuits. D/A converters A5U2 and A5U7 are controlled by digital data bits D0 through D7 from the microprocessor circuits to permit oscillator frequency adjustment in 1 Hz, 10 Hz, 100 Hz and 200 Hz steps, respectively, on the four operating bands.

4-76. The sinusoidal AF signal generated by the oscillator is applied through normally closed contacts of relay A5K2, operational amplifiers A5U4c and A5U10, and normally closed contacts of relay A5K1 to the AM channel and FM printed circuit boards, where it may be used for modulation of the instrument RF output.

The sinusoidal AF signal is also applied to D/A converter A5U9, which functions with D/A converter A5U8 as a precision attenuator and the output from the attenuator is applied through operational amplifier A5U11 to the front panel MOD OSC OUTPUT connector. D/A converters A5U8 and A5U9, under control of the microprocessor circuits, can adjust this output over a range of 0 to 4.095 volts in 1 millivolt steps.

4-77. Relays A5K1 and A5K2 are energized by data bits D7 and D6 from the microprocessor circuits when frequency sweep operation is selected. D/A converters A5U8 and A5U9 are then operated by the microprocessor circuits as a ramp generator and the ramp voltage developed by this circuit is applied through operational amplifier A5U11 to the front panel MOD OSC OUTPUT connector and through contacts of relay A5K1 to the AM channel and FM printed circuit boards. Potentiometer A5R47 is used to set the level of the ramp voltage supplied to the printed circuit boards.

4-78. Control logic for the modulation oscillator circuits is contained on I/O printed circuit board A6. Data from the microprocessor data bus is applied to the modulation oscillator data bus through buffer A6U9 when the buffer is addressed and the data is routed to the appropriate latch in the modulation oscillator circuits through decoding of address information by decoder A6U4.

Data is loaded from the data bus into the addressed latch and is then available for control function. Latch A5U15 stores data that specify the oscillator frequency; latch A5U14 stores data that specify oscillator band selection and relay operation. In addition, latch A5U14 provides four bits of data to latch A5U13 which, together with latch A5U12, provide 12 parallel bits of data to D/A converters A5U8 and A5U9 for output AM amplitude selection or ramp generation. The use of 12 data bits for this function improves resolution.

4-79. Amplitude Modulation Circuits. Refer to Figure 4-15. The amplitude modulation circuits process AF signals used to amplitude modulate the RF signal in the output circuits. Input AF modulation signals may be supplied from the internal modulation oscillator circuits or from an external modulation signal source. If the external modulation signal source is used, input AF signals are applied to the front panel AM INPUT connector; signal amplitude must be 1 volt RMS if instrument modulation display accuracy is to be maintained.

The amplitude of the AF modulating signal is adjusted by the amplitude modulation circuits to the level required to produce the selected modulation depth and the processed AF modulation signal is applied to the output circuits where amplitude modulation actually occurs.

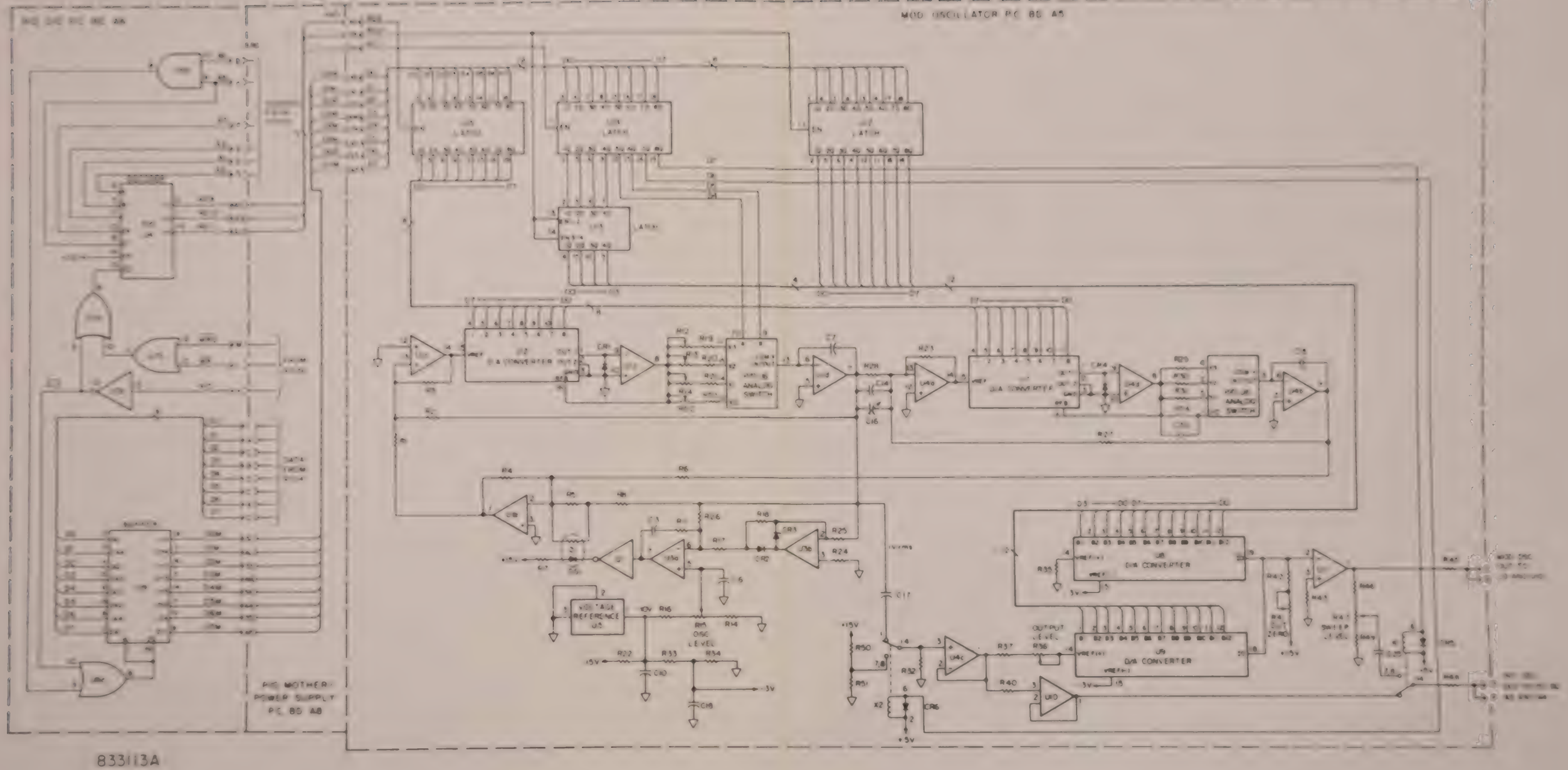

Figure 4-14. Modulation Oscillator Circuits, Detailed Block Diagram

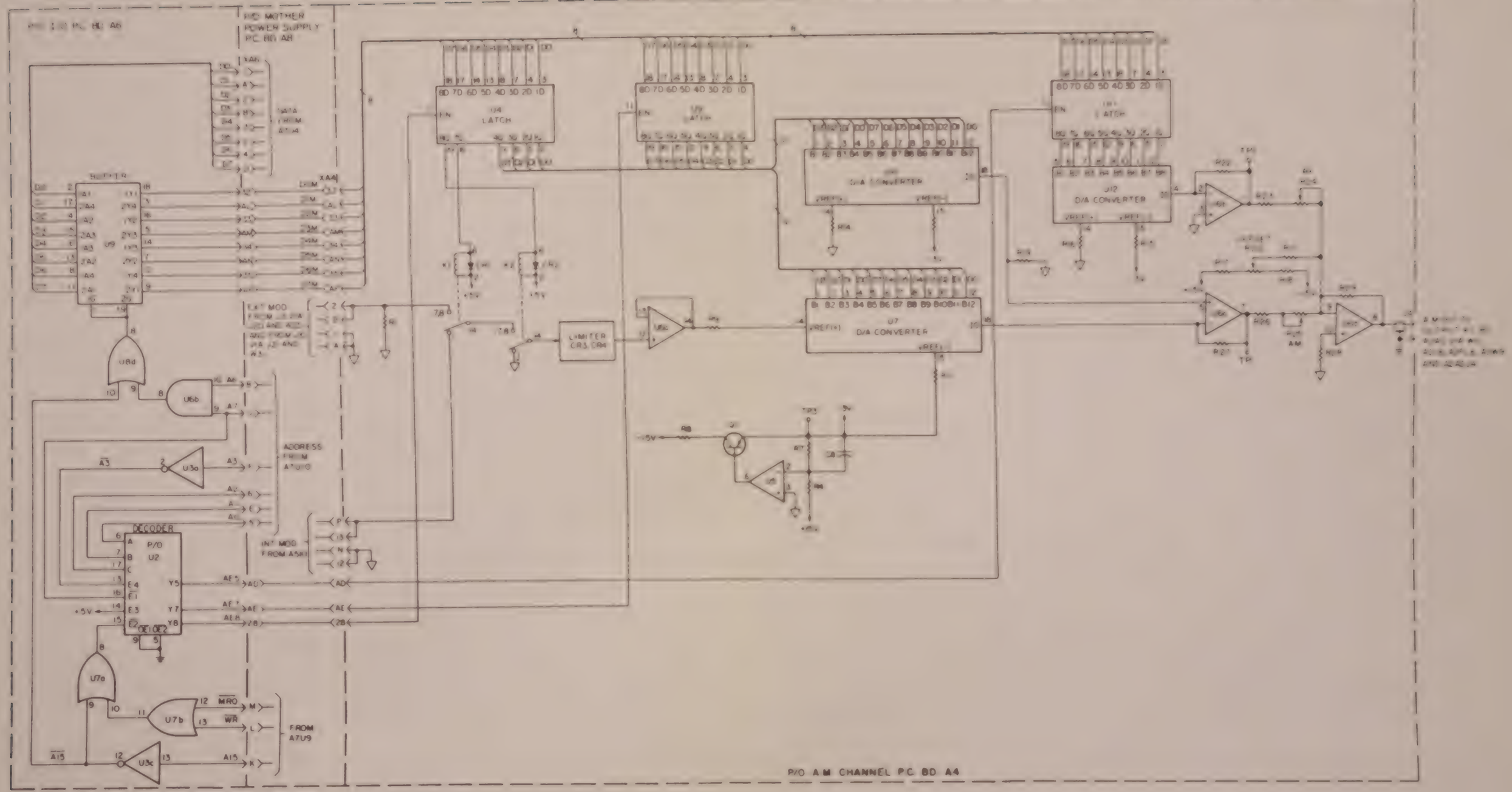

Figure 4-15. Amplitude Modulation Circuits, Detailed Block Diagram

4-80. Application of input AF modulation signals to the amplitude modulation circuits is controlled by relays A4K1 and A4K2, which is energized by data supplied by the microprocessor circuits. Relay A4K2 is deenergized if the AM off function is selected and is energized if either the internal AM or external AM function is selected. Relay A4K2 is energized to select the modulation signal from the external modulation signal source and is deenergized to select the internal modulation oscillator as the modulation signal source. The selected AF modulation signal is applied through contacts of the two relays, clamps A4CR3 and A4CR4, and operational amplifier A4U6a to D/A converter A4U7.

4-81. D/A converters A4U7 and A4U10 are used as precision attenuators. Under control of data supplied by the microprocessor circuits, they provide attenuation of the AF modulating signal. Modulation depths from 0 to 99.9 percent with a resolution of 0.1 percent may be selected.

Reference voltage of -3 volts for the D/A converters is derived from the -15 volt supply by a series voltage regulator consisting of series regulator A4Q1 and error amplifier A4U5. The output of D/A converters A4U10 and A4U7 is applied through operational amplifier A4U6c to operational amplifier A4U6d. Potentiometer A4R25 permits calibration of the AF modulating signal.

4-82. The attenuated AF signal is superimposed on a DC level that is proportional to the selected instrument output RF level. The microprocessor circuits supply data to D/A converter A4U12 in accordance with instrument output level selection and D/A converter A4U12 converts the applied digital data to an analog DC level which is applied through operational amplifier A4U6b to operational amplifier A4U6d.

Potentiometer A4R24 permits calibration of this DC level. Adjustment of the instrument RF output level is thereby performed in fine steps in the amplitude modulation circuits and coarse adjustment is performed by the attenuator assembly in the output circuits. The composite AF and DC signal is supplied to the output circuits through operational amplifier A4U6d.

4-83. Control logic for the amplitude modulation circuits is located on I/O printed circuit board A6. Data from the microprocessor data bus is supplied to the data bus on AM channel printed circuit board A4 through buffer A6U9 when the buffer is addressed by the microprocessor.

Decoder A6U2 decodes address information from the microprocessor to cause loading of data into the appropriate latch. Latch A4U4 stores relay data into the appropriate latch. Latch A4U4 stores relay data and, with latch A4U9, permits parallel loading of 12 data bits that specify modulation depth into D/A converters A4U10 and A4U7. Latch A4U11 stores data that specify instrument RF output level.

4-84. Frequency and Phase Modulation Circuits. Refer to Figure 4-16. The frequency and phase modulation circuits process AF or ramp signals used to modulate the main oscillator of the instrument. Modulation signals may be supplied from the internal modulation oscillator circuits or from an external modulation source.

An external modulation signal level of 1 volt RMS is required for programmed deviation. Selected modulation signals are attenuated and scaled to the value required to produce the selected deviation and are then supplied to a varactor in the tuning circuit of the selected band oscillator.

4-85. Three relays, controlled by data from the microprocessor circuits, control circuit configuration, relay A3K1 selects input modulation signals from either the internal modulation oscillator circuit or from the external modulation signal source; relay A3K2 selects either the frequency modulation function (relay deenergized) or the phase modulation function (relay energized); and relay A3K3 is the frequency and phase modulation circuit on/off control.

Input modulation signals are supplied through contacts of relay A3K1, overload clamps A3CR1 and A3CR2, and operational amplifier A3U1 to D/A converter A3U3, which functions with D/A converter A3U6 as a precision attenuator. A reference voltage of -4 volts for the D/A converters is derived from the -15 volt supply by a series regulator circuit consisting of series transistor A3Q1 and error amplifier A3U4.

The two D/A converters provide attenuation of the modulation signal in accordance with data supplied from the microprocessor circuits. This data specifies the selected deviation. The attenuated modulation signal is applied through operational amplifier A3U7 to a potentiometer network, which provides a separate calibration potentiometer for each band oscillator in the instrument.

Data that specify the band oscillator in use are supplied from the microprocessor circuits to analog multiplexer A3U8 and the multiplexer selects the modulation signal from the corresponding potentiometer for application to integrated circuit A3U9. Integrated circuit A3U9 functions as a buffer for the frequency modulation function and as a differentiator for the phase modulation function. The contact of relay A3K2 change the circuit configuration in accordance with modulation mode selection.

4-86. Frequency modulation, phase modulation, and frequency sweep all take place in the main oscillator circuit of the instrument. Deviation is therefore effected by any frequency multiplication or frequency division that occur in the frequency processor circuits. For this reason, it is necessary to scale the modulation signal according to the frequency conversion process that is to be used in order to achieve the selected final deviation.

Analog multiplexer A3U11 and a voltage divider network at its input perform this function. The analog multiplexer selects the appropriate tap on the voltage divider in accordance with data supplied through latch A3U13 from the microprocessor circuits. The scaled modulation signal is supplied through operational amplifier A3U13 and contacts of relay A3K3 to operational amplifier A3U19.

Analog switch A3U14 performs scaling for the modulation signal by adjusting the feedback of operational amplifier A3U13. Data that specify the selected sweep width are supplied to analog switch A3U14 through latch A3U12 from the microprocessor circuits to select the required scaling.

4-87. To compensate for distortion produced by the varactor modulator, a second-harmonic nulling loop is connected at the input of operational amplifier A3U19. The modulation signal frequency is doubled by analog multiplier A3U15, and is applied through operational amplifiers A3U16 and A3U17 to a potentiometer network that enables harmonic null adjustment for each of the seven band oscillators in the instrument.

Selection of the proper potentiometer is made by analog switch A3U18 according to data supplied from latch A3U10. The second-harmonic signal from the selected potentiometer is applied through analog switch A3U18 to the input of amplifier A3U19 with a 180 degree phase relationship to the second-harmonic produced by the varactor (predistortion) thereby nulling the second-harmonic component. Potentiometers A3R30 through A3R66 permit amplitude adjustment of the second-harmonic signal for accurate harmonic nulling for each band oscillator.

4-88. The modulation signal is then amplified by operational amplifier A3U19 and transistors A3Q2 and A3Q1. A varactor in the tuning circuit of the selected band oscillator is driven by the output modulation signal to vary the oscillator frequency at the modulation signal rate. If the FM or PM off function is selected, the input to operational amplifier A3U19 is grounded. A DC bias of approximately +15 volts is always present at the output of the amplifier.

4-89. Control logic for the frequency and phase modulation circuits is located on I/O printed circuit board A6. Data from the microprocessor data bus is supplied to the data bus on FM printed circuit board A3 through buffer A6U9 when the buffer is addressed.

Data is loaded into the appropriate latch on the FM printed circuit board through a decoding of address information by decoder A6U2. Latch A3U2 stores relay control data and with latch A3U5, permits parallel transfer of 12 data bits that specify selected deviation to D/A converters A3U6 and A3U3. Latch A3U10 stores data that specify the band oscillator in use and latch A3U12 stores scaling data.

4-90. Power Supply Circuits. Refer to Figure 4-17. Two DC power supplies are located on mother/power supply printed circuit board A8: a standby power supply that supplies +24 volts DC to the oven of the temperature stabilized reference oscillator on the mother/power supply board and +5 volts to the non-volatile memory in the microprocessor circuits; and a main power supply that develops regulated output voltages of +5, -5.2, +15,-15, and +70 volts for most of the other circuits. (Low-noise) power supplies in the main oscillator and frequency/phase lock circuits develop +12 and -12 volts from the +15 and -15 volt supplies.)

4-91. The standby power supply is powered whenever the instrument is connected to the AC line. AC line voltage is applied to the primary winding of transformer T2 through power fuse F2. Rear panel switch S2 can be set to accommodate line voltages of 100,120,220, or 240 volts. The applied line voltage is stepped down by transformer T2 and rectified by bridge rectifier A8CR5.

Voltage regulator A8U7 develops regulated +24 volts DC from the rectifier output, and voltage regulator A8U6 develops regulated +5 volts. The regulated +5 volts turns on transistor A9Q4 through diode A8CR6 and approximately +5 volts is applied to the non-volatile memory circuits through transistor A8Q4 from the +24 volt supply. If the +5 volts is interrupted for any reason, battery A8BT1 powers the non-volatile memory, thereby ensuring retention of stored data.

The regulated +5 volts from the standby power supply also switches on solid-state relay K1 when the front panel POWER ON switch is actuated, to enable operation of the main power supply. CPU control circuits also receive a +2.5 volt reference voltage derived from the regulated +5 volts by a voltage divider.

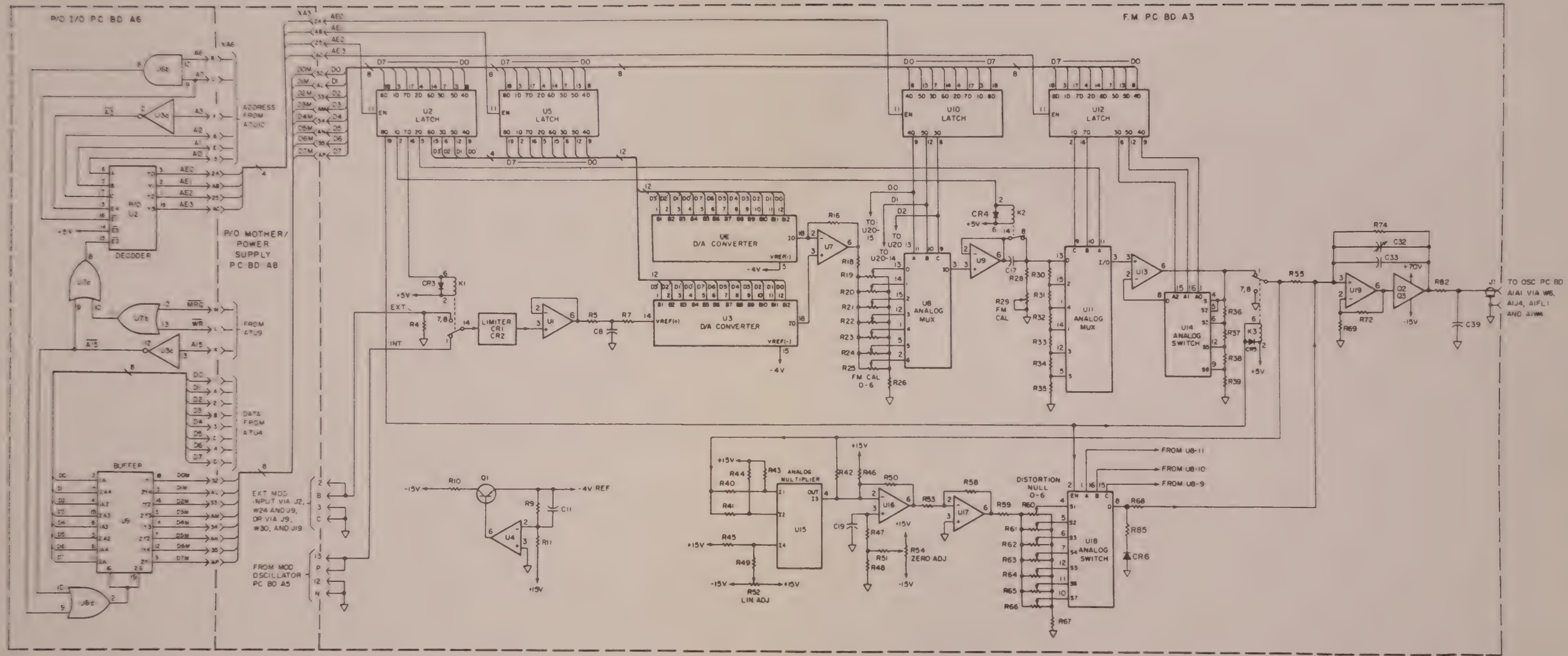

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Figure 4-16. Frequency and Phase Modulation Circuits, Detailed Block Diagram

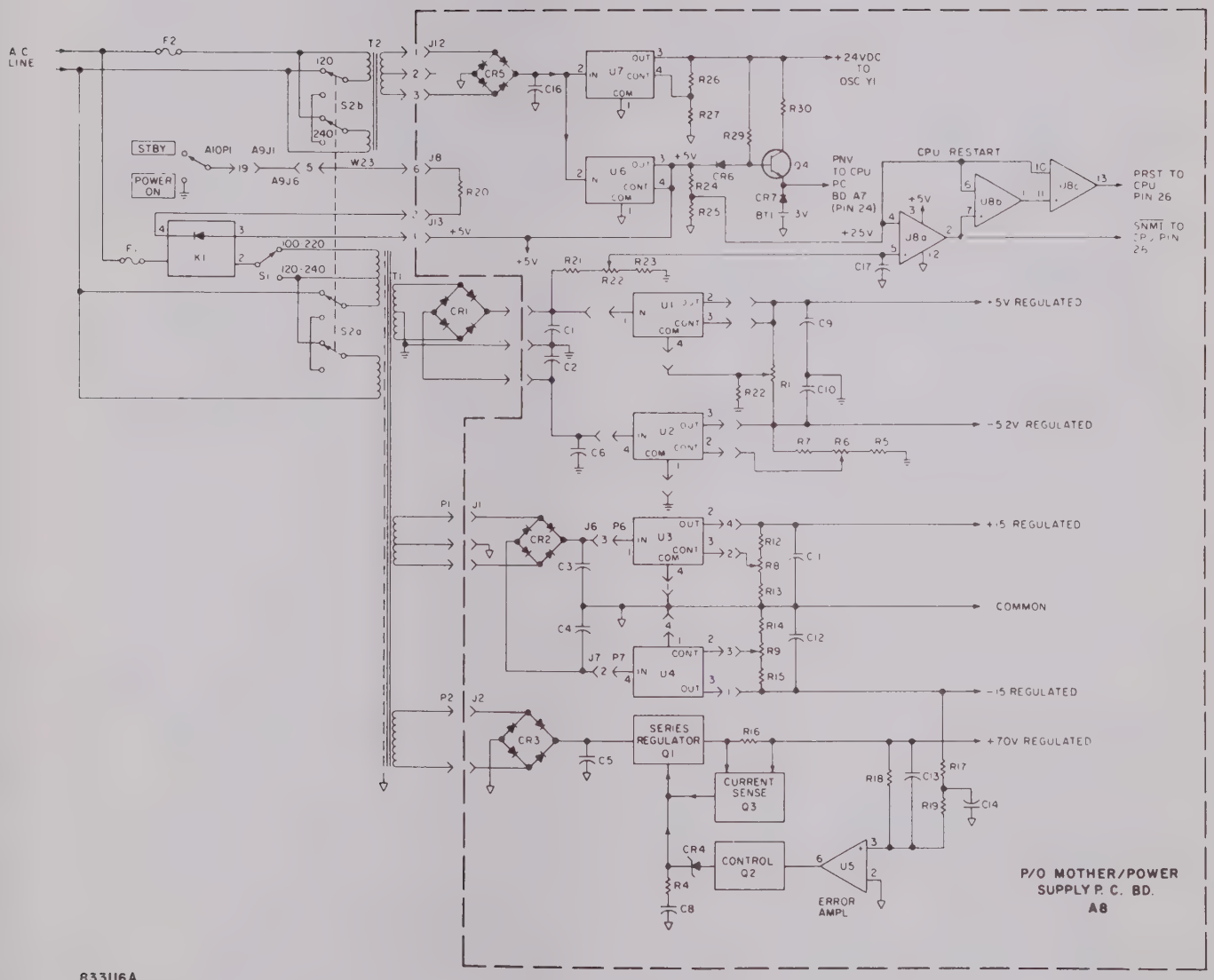


Figure 4-17. Power Supply Circuits, Detailed Block Diagram

4-92. When solid state relay K1 is energized, AC line power is applied through fuse F1, relay K1, and rear panel voltage selector switches S1 and S2 to primary windings of transformer T1.

Switches S1 and S2 can configure the primary windings to accommodate line voltages of 100, 120, 220. or 240 volts. Three secondary windings of transformer T1 power separate DC supplies that develop +5 and -5.2 volts, +15 and -15 volts, and +70 volts.

4-93. Bridge rectifier CR1 develops the DC from which the +5 and -5.2 volts are derived. The DC output of the rectifier is monitored by CPU restart circuits. If the DC voltage drops below a level set by potentiometer A8R22 as a result of a malfunction or instrument power down, signal $\overline{\text{SNMI}}$ is activated through voltage comparator A8U8a and this signal causes operation of the microprocessor circuits to stop.

Signal PRST is also set low through voltage comparators A8U8b and A8U8c. When the DC voltage at the output of rectifier CR1 returns to the normal level, signal $\overline{\text{SNMI}}$ is deactivated and signal PRST is activated, causing the CPU to be reset.

The CPU then resumes operation from the start of its program. The DC output of bridge rectifier CR1 also powers voltage regulators A8U1 and A8U2, which develop regulated output voltages of +5 and -5.2 volts, respectively. Potentiometer A8R11 provides means for adjusting the regulated +5 volts and potentiometer A8R6 provides means for adjusting the -5.2 volts.

4-94. Bridge rectifier A8CR2 develops a DC voltage from which the +15 and -15 volts are derived by voltage regulators A8U3 and A8U4 respectively. Potentiometers A8R8 and A8R9 provide means for adjusting the +15 and -15 volts respectively.

4-95. The regulated +70 volts is developed from the output of bridge rectifier A8CR3 through series regulator A8Q1. Error amplifier A8U5 senses voltage variations in the +70 volt output and supplies error signals to control transistor A8Q2, which drives series regulator A8Q1 in the proper direction to compensate for the change in output voltage.

A DC voltage proportional to output current is developed across resistor A8R16. This DC voltage is monitored by current sensing transistor A8Q3. When output current reaches a predetermined limit, transistor A8Q3 reduces the output voltage through series regulator A8Q1 to hold the output current to a safe level.

SECTION V

MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains the safety requirements, test equipment required, inspection procedure, performance tests, adjustment procedures, and trouble-shooting for the Model 1030. Refer to Figure 5-1 for the Model 1030 Tests Points and Adjustments Location Diagram.

5-3. SAFETY REQUIREMENTS.

5-4. Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation and maintenance of the instrument. Failure to comply with the precautions listed in the Safety Summary located in the front of this manual could result in serious injury or death. Service and adjustment should be performed only by qualified service personnel.

5-5. TEST EQUIPMENT REQUIRED.

5-6. Test equipment required for the performance tests and adjustment procedures is listed in Table 5-1.

5-7. INSPECTION.

5-8. If an equipment malfunction occurs, perform a visual inspection of the Model 1030. Inspect for signs of damage caused by excessive shock, vibration, or overheating, such as broken wires, loose hardware and parts, loose electrical connections, electrical shorts, cold solder connections, or accumulations of dirt and other foreign matter. Correct any problems discovered, then perform the performance tests to verify that the instrument is operational. If a malfunction persists or the instrument fails any of the performance tests refer to the adjustment procedures. After the instrument has been adjusted, perform the performance tests to verify instrument operation.

5-9. PERFORMANCE TESTS.

5-10. The performance tests consist of the following tests:

a. Power supply trip level test.

b. Power supply voltage test.

c. Display and keyboard test.

d. CPU board test.

e. Time base accuracy test.

f. Frequency accuracy test.

g. RF output level test.

h. RF output distortion and spurious signal test.

i. Modulation oscillator test.

j. Frequency modulation test.

k. Phase modulation test.

l. Amplitude modulation test.

m. External modulation test.

n. Sweep test.

5-11. Power supply trip level test. The power supply trip level test verifies that the trip level for the low-line error message (LO-LINE) is set at 108 VAC.

5-12. Perform the test as follows:

a. Set the rear panel line voltage switch to the 120 V position.

b. Verify that the line fuse is the proper value as listed.

c. Connect a DVM set to measure VAC to the variac and connect the variac to a 120 VAC supply. Adjust the variac for 120 VAC.

d. Connect the instrument power cord to the variac and set the instrument power ON/STBY switch to ON. The display should contain all dashes for a period of three seconds, followed by a normal data display corresponding to the setting of the instrument when it was last shut off.

e. Adjust the variac for 105 VAC.

f. The instrument should indicate (LO-LINE).

g. Set the instrument power ON/STBY switch to OFF and set the variac for 108 VAC.

h. Set the instrument power ON/STBY switch to ON, the display should indicate as specified in step d.

5-13. Power supply voltage test. The power supply voltage test measures the +5, -5.2, +15, -15, +68, VDC power supply voltages and the +3 VDC lithium battery voltage.

5-14. Perform the test as follows:

a. Disconnect all power to the instrument and remove the top cover.

b. Set the variac for 120 VAC and connect the instrument power cord to the variac.

c. Set the instrument POWER ON/STBY switch to ON.

d. Use a DVM set to measure VDC and measure the voltage at the points listed in Table 5-2.

TABLE 5-1. MAINTENANCE TEST EQUIPMENT REQUIRED

Equipment	Specifications	Model
Oscilloscope 10.1 Probe	100 MHz bandwidth 5 mV sensitivity	Hewlett-Packard 1740A
RF Microwattmeter (With sensor)	10 nW to 100 mW full scale, 200 kHz to 12 GHz	Boonton Electronics 4200 with 4200-5 sensor
Digital AC/DC Voltmeter	5½ digits	Dana 5001
Frequency Counter	0.00005 Hz to 500 MHz, sensitivity to 20 mV	Hewlett-Packard 5345
Audio Analyzer	20 Hz to 100 kHz	Hewlett-Packard 8903A
Function Generator	0.004 Hz to 4 MHz	Wavetek 182A
Modulation Meter	10 MHz to 1.2 GHz, 100% AM, 300 kHz FM deviation	Boonton Electronics 82AD
Extender Card	------	Boonton Electronics 954012
Autotransformer	0 to 135 volts AC output	General Radio Variac
Spectrum Analyzer	------	H-P 182T
10 dB Attenuator	------	H-P 8491A/10

TABLE 5-2 POWER SUPPLY TEST POINTS

Measurement Point	Voltage
A8AX7, pin 22	+5.0 ±0.02 VDC
A8AX7, pin 21	-5.2 ±0.02 VDC
A8AX7, pin 19	+15.0 ±0.02 VDC
A8AX7, pin 18	-15.0 ±0.02 VDC
A8AX7, pin 16	+68 ±2.0 VDC
A8BT1	+3 VDC minimum

5-15. Display and Keyboard test. The display and keyboard test verifies that the annunciators, displays, and keyboard keys are operational.

5-16. Perform the test as follows:

a. Set Option/test switch A6S1 on I/O board A6 to test 0 position, as shown.

A6S1 1 2 3 4 5
↑ ↑ ↑ ↑ ↓

↓ = Open and ↑ = Closed

b. All segments of the digital display and the AM INT, AM EXT, FM INT, FM, EXT, RF, SWP, MOD OSC FREQ, MOD OSC LEVEL, and KNOB LEDs should be illuminated.

c. Set Option/test switch A6S1 to the normal position as shown.

A6S1 1 2 3 4 5
↑ ↑ ↑ ↑ ↑

d. The display should indicate 100.00000 MHz.

e. Press the KNOB key and the PRESET FREQ STEP kHz 100 key. Rotate the knob clockwise, then counter clockwise; the displayed frequency should increase, then decrease in 0.1 MHz steps.

f. Set the Option/test switch A6S1 to test 1 position, as shown.

A6S1 1 2 3 4 5
↓ ↑ ↑ ↑ ↓

g. Refer to Table 5-3 and press each key listed. As each key is pressed the display should indicate the code listed next to the key.

h. Set the Option/test switch A6S1 to the normal position as shown in step c.

TABLE 5-3. Display and Keyboard Data

Key	Display	Key	Display
MOD OSC LEVEL	68	mV/MHz	75
MOD OSC FREQ	62	mV/kHz	76
AM	63	Δ F	60
AM OFF	83	dBm	73
AM INT	82	dBμV	69
AM EXT	81	CLR	84
FM	61	ENTER/Hz RAD %	74
PM	67	FREQ (carrier)	59
FM OFF	79	PRESENT FREQ STEP kHz 100	91
FM INT	78	PRESENT FREQ STEP kHz 10	92
FM EXT	77	PRESENT FREQ STEP kHz 1	93
7	55	PRESENT FREQ STEP kHz 0.1	94
4	52	↑ (step up)	72
1	49	↓ (step down)	71
0	48	LEVEL (output)	64
8	56	SWP 1	88
5	53	SWP 2	89
2	50	SWP 3	90
. (period)	46	SWP	95
SRQ	85	KNOB	87
9	57	ADRS	58
6	54	PROG RCL	66
3	51	PROG STO	65
- (dash)	45	RF	80
V/GHz	70		

5-17. CPU board test. The CPU board test verifies that the CPU board is operational.

5-18. Perform the test as follows:

a. Set the instrument POWER ON/STBY switch to ON.

b. Press the INIT(LOCAL) key. After approximately two seconds, the instrument should display: Hz deviation, 100.00000 MHz, and 0.0 dB output level.

c. Store this initialize setup in program locations 64, 90, 147, 195, and 248. Refer to Section III, paragraph 3-24.

d. Recall program locations 64, 90, 147, 195, and 248. The instrument display should be the same as in the initialize set up with no errors displayed. Refer to Section III, paragraph 3-25.

5-19. Time base accuracy test. The time base accuracy test verifies that the time base accuracy is within tolerance.

5-20. Perform the test as follows:

a. Set the instrument POWER ON/STBY switch to ON and allow the instrument to warm up for one hour.

b. Connect the frequency counter to the instrument rear panel 10 MHz REF REF IN/OUT connector and set the INT EXT 10 MHz REF switch to the INT position.

c. Set the frequency counter for a 10 second gate time and observe the output frequency. The frequency counter display should indicate 9.999970 MHz to 10.000030 MHz (equivalent to ±3 ppm).

NOTE

The Model 1030 time base is initially set at the factory to an accuracy of 0.01 ppm/day, the maximum expected drift in one year is approximately 3 ppm. The above tolerance allows for a typical one year uncertainty. Refer to the time base accuracy adjustment if readjustment is necessary.

5-21. Frequency Accuracy test. The frequency accuracy test verifies that the output frequency is within tolerance.

5-22. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. RF (on)

3. FREQ STEP kHz PRESET (0.1 kHz)

b. Connect the frequency counter to the instrument RF OUT connector.

c. Observe the frequency counter, the display should indicate 99.99970 MHz to 100.00030 MHz.

NOTE

The following procedure will be simplified if the instrument time base is used as the counter time base, or the ratio of the instrument output frequency to the instrument time base is measured, rather than the absolute frequency.

d. Press the ↑ key to increment the output frequency by 100 Hz and verify that a 100 Hz change has occurred. Continue to press the ↑ key and check each 100 Hz increment until at least a 1 kHz change has been accumulated.

e. Press the 100 kHz FREQ STEP kHz PRESET key and increment the frequency by pressing the ↑ key until at least 1 MHz has been accumulated.

NOTE

If absolute frequency measurements are made the instrument time base error must be accounted for in the above procedure. This is not necessary if the instrument time base is used as the counter time base, or if ratios are measured.

f. Verify each of the following output frequencies:

0.1500 MHz	95.4999 MHz
1.9999 MHz	95.5000 MHz
2.0000 MHz	134.9999 MHz
33.7499 MHz	135.0000 MHz
33.7500 MHz	149.0499 MHz
47.7499 MHz	149.0500 MHz
47.7500 MHz	164.5699 MHz
67.4999 MHz	164.5700 MHz
67.5000 MHz	

5-23. RF output level Test. The RF output level test verifies that the RF output level is within tolerance.

5-24. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. RF (ON)

b. Zero and calibrate the RF microwattmeter according to the manufacturer's instructions.

c. Connect the RF microwattmeter to the instrument RF OUT connector. The RF microwattmeter display should indicate between -1.5 dBm and +1.5 dBm.

d. Set the instrument to 10.0000 MHz, 50.0000 MHz, and 100.0000 MHz. The variations in RF output level should not exceed 3 dBm.

e. Connect a 10-3B attenuator between the instrument RF OUT connector and the input to the RF microwattmeter.

f. Set the instrument for an output level of +16.0 dBm at a carrier frequency of 100 MHz.

g. Enter a dB REF LEVEL into the RF microwattmeter so that the display indicates exactly +16.00 dBr.

h. Set the instrument for a LEVEL STEP dB PRESET of 0.1 dB. Press the ↑ key repeatedly and verify that the relative RF output level is within ±0.3 dB for each output step from +16.0 dBr to +12.1 dBr.

i. Set the instrument for an output level of +16.0 dBm. Press the ↑ key repeatedly and verify that the relative RF output level is within ±0.5 dB from +16.0 dBr to +23 dBr.

j. Set the instrument for an output level of +16.0 dBm. Remove the 10 dB attenuator.

k. Set the irstrument for LEVEL STEP dB PRESET of 1 dB.

l. Enter a dB REF LEVEL into the RF microwattmeter so that the display indicates exactly 00.00 dBr.

m. Press the ↑ key repeatedly and verify that the relative RF output level is within ±1 dB from 00.00 dBr to -50.00 dBr.

CAUTION

Zero the RF microwattmeter and avoid thermal gradients while making these low-level measurements.

n. Disconnect the RF microwattmeter from the instrument RF OUT connector.

o. Connect the spectrum analyzer to the instrument RF OUT connector. Using the appropriate bandwidth and scan-width controls, in conjunction with the IF level, set the analyzer display to the top reference graticule.

p. Set the instrument LEVEL STEP dB PRESET to 10 dB. Press the ↓ key repeatedly and verify that the RF output level decreases in approximately 10 dB steps from -50 dBm to -90 dBm.

NOTE

It will be necessary to adjust the setting of the spectrum analyzer to optimize the display characteristics at lower input levels.

5-25. RF output distortion and spurious signal test. The RF output distortion and spurious signal test verifies that the RF output distortion and spurious signals are at least 30 db below the carrier.

5-26. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. FREQ (179.999 MHz)

3. FREQ STEP kHz PRESET (100 kHz)

4. LEVEL (+16 dBm)

5. RF (ON)

CAUTION

To avoid damage to the spectrum analyzer's input attenuator circuitry, set the analyzer for full span.

b. Connect the spectrum analyzer to the RF OUT connector of the instrument.

c. Press the instrument KNOB key and slowly decrease the frequency while observing the RF harmonics on the spectrum analyzer. Harmonics should always be at least 30 dB below the carrier.

d. Continue checking down to a carrier frequency of 250 kHz. At these low frequencies, more harmonics will be observed, and there will be some spurious signals contributed by the analyzer. Identify these false signals by using the alternate IF switch.

5-27. Modulation oscillator test. The modulation oscillator test verifies that the internal modulation oscillator is operating within tolerance.

5-28. Perform the test as follows:

a. Set the instrument controls as follows:

1. MOD OSC FREQ (1.00 kHz)

2. MOD OSC LEVEL (1.00 V)

b. Connect the instrument MOD OSC OUTPUT connector to the audio analyzer.

c. Check the frequency, level, and distortion on the audio analyzer. The indicated frequency should be 1.00 kHz ±1%. The level should be 1.00 V rms ±2% and the t.h.d. should be less than 0.05%.

d. Verify that the frequencies are correct to ±1% and the levels are 1.00 V rms ±2% at each of the following modulation oscillator frequencies.

20 Hz	1 kHz
249 Hz	2.49 kHz
250 Hz	2.50 kHz
400 Hz	10 kHz

e. Set the modulation oscillator frequency to 20 kHz and 25 kHz and verify that the frequencies are correct ±2% and the levels are 1.00 V rms ±2%.

5-29. Frequency modulation test. The frequency modulation test verifies that the FM modulation circuitry is operating within tolerance.

5-30. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. FM (200 kHz)

3. FM/PM INT (ON)

4. RF (ON)

5. MOD OSC FREQ (1.00 kHz)

6. MOD OSC LEVEL (1.00 V)

b. Connect the instrument RF OUT connector to the input of the modulation meter and connect the AF output of the modulation meter to the input of the audio analyzer.

c. Set the modulation meter to FM, 300 kHz f.s. deviation, 30 Hz to 15 Hz bandwidth.

d. Refer to Table 5-4 and verify that each carrier frequency and FM deviation is correct within ±5% and the t.h.d., as indicated on the audio analyzer is less than 0.1%.

NOTE

Change the FM ranges of the modulation meter appropriately.

TABLE 5-4. FM Modulation Checks

Carrier Frequency	FM Deviations
179.999900	200 kHz
134.999950	100 kHz
67.499975	50 kHz
33.749975	25 kHz
16.874995	12 kHz
8.437495	6 kHz
4.218745	3 kHz
2.109370	12 kHz

5-31. Phase-Modulation test. The phase modulation test verifies that the PM modulation circuitry is operating within tolerance.

5-32. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.
2. PM (16 rad.)
3. FM/PM INT (ON)
4. FREQUENCY (100.00000 MHz)
5. RF (ON)
6. MOD OSC FREQ (20.0 kHz)
7. MOD OSC LEVEL (1.00 V)

b. Connect the instrument RF OUT connector to the input of the modulation meter.

c. Set the modulation meter to FM, 300 kHz f.s. deviation, 30 Hz to 200 kHz bandwidth. The modulation meter should read 160.0 kHz ±5%.

5-33. Amplitude modulation test. The amplitude modulation test verifies that the AM modulation circuitry is operating within tolerance.

5-34. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.
2. AM (90%)
3. AM INT (ON)
4. LEVEL (-4 dBm)
5. RF (ON)
6. MOD OSC FREQ (1.00 kHz)
7. MOD OSC LEVEL (1.00 V)

b. Connect the instrument RF OUT connector to the input of the modulation meter and connect the AF output of the modulation meter to the input of the modulation analyzer.

c. Set the modulation meter to AM, 100% f.s. Verify that the AM calibration as indicated on the modulation meter, is correct within ±5.5% and that the t.h.d., as indicated on the audio analyzer, is less than 4% at each of the following frequencies:

33.7499 MHz	95.5000 MHz
33.7500 MHZ	134.9999 MHz
47.7499 MHz	135.0000 MHz
47.7500 MHz	149.0499 MHz
67.4999 MHz	149.0500 MHz
67.5000 MHz	164.5699 MHz
95.4999 MHz	164.5700 MHz

d. Set the instrument RF output level to -3.9 dBm and repeat step (c).

e. Set the instrument RF output level to -4 dBm and the amplitude modulation to 70%. Verify that the AM calibration as indicated on the modulation meter is correct within ±4.5% and that the t.h.d. as indicated on the audio analyzer is less than 2% at each of the following frequencies.

10.0000 MHz

100.0000 MHz

50.0000 MHz

f. Change the instrument RF output level to -3.9 dBm and repeat step (e).

g. Set the instrument RF output level to -4 dBm and the amplitude modulation to 50%. Verify that the AM calibration, as indicated on the modulation meter, is correct within ±3.5% and the t.h.d., as indicated on the audio analyzer, is less than 1% at each of the following frequencies:

50 MHz	157 MHz
25 MHz	173 MHz
142 MHz	

h. Change the instrument RF output level to -3.9 dBm and repeat step (g).

5-35. External modulation test. The external modulation test verifies that the instrument is operational utilizing external modulation.

5-36. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. AM (70%)

3. AM EXT (ON)

4. RF (ON)

b. Connect 8903A high output to the instrument AM Input and set the 8903A controls as follows:

1. FREQUENCY (1 kHz)

2. AMPLITUDE (2 V)

3. Press the DISTORTION key.

c. Connect 82AD RF input to the instrument RF OUT and set the 82AD controls as follows:

1. TUNING (AUTO)

2. FILTERS (30 Hz and 15 kHz)

3. PEAK $\left(\frac{Pk\text{-}Pk}{2}\right)$

4. RANGE (100)

5. FUNCTION (% AM)

d. The 82AD should indicate 70.0% AM ±5% and the 8903A should indicate <0.7% distortion.

e. Disconnect the 8903A from the instrument AM input and connect it to the instrument FM input.

f. Set the 82AD controls as follows:

1. TUNING (AUTO)

2. FILTERS (30 Hz and 15 kHz)

3. PEAK $\left(\frac{Pk\text{-}Pk}{2}\right)$

4. RANGE (300)

5. FUNCTION (FM)

g. Set the instrument controls as follows:

1. AM OFF (OFF)

2. FM EXT (ON)

3. FM (200 kHz)

h. The 82AD should indicate 200 kHz deviation ±5% and the 8903A should indicate <0.1% distortion.

5-37. Sweep test. The sweep test verifies that the sweep function of the instrument is operating within tolerance.

5-38. Perform the test as follows:

a. Set the instrument controls as follows:

1. Press the INIT (LOCAL) key.

2. FREQ (142.03 MHz)

3. RF (ON)

4. Press the SWP1 key.

b. Connect the instrument RF output to the RF input of the spectrum analyzer and set the spectrum analyzer to analyze the carrier frequency. The sweep width should be approximately 10% of the carrier frequency.

c. Press the instrument SWP2 key. The sweep width should be approximately ±2.4 MHz as shown on the spectrum analyzer.

d. Press the instrument SWP3 key. The sweep width should be approximately ±1.2 MHz as shown on the spectrum analyzer.

5-39. ADJUSTMENTS.

5-40. The adjustments consist of the following:

a. Power supply trip level adjustment.

b. Power supply voltage adjustment.

c. 10 MHz reference adjustment.

d. Oscillator adjustments.

e. Modulation oscillator adjustments.

f. FM board adjustments.

g. AM board adjustments.

5-41. Power supply trip level adjustment. The power supply trip level adjustment sets the trip level for the low-line error message (LO-LINE) and the low-line voltage condition, that interrupts the processor operation until the proper AC voltage is applied.

5-42. Perform the adjustment as follows:

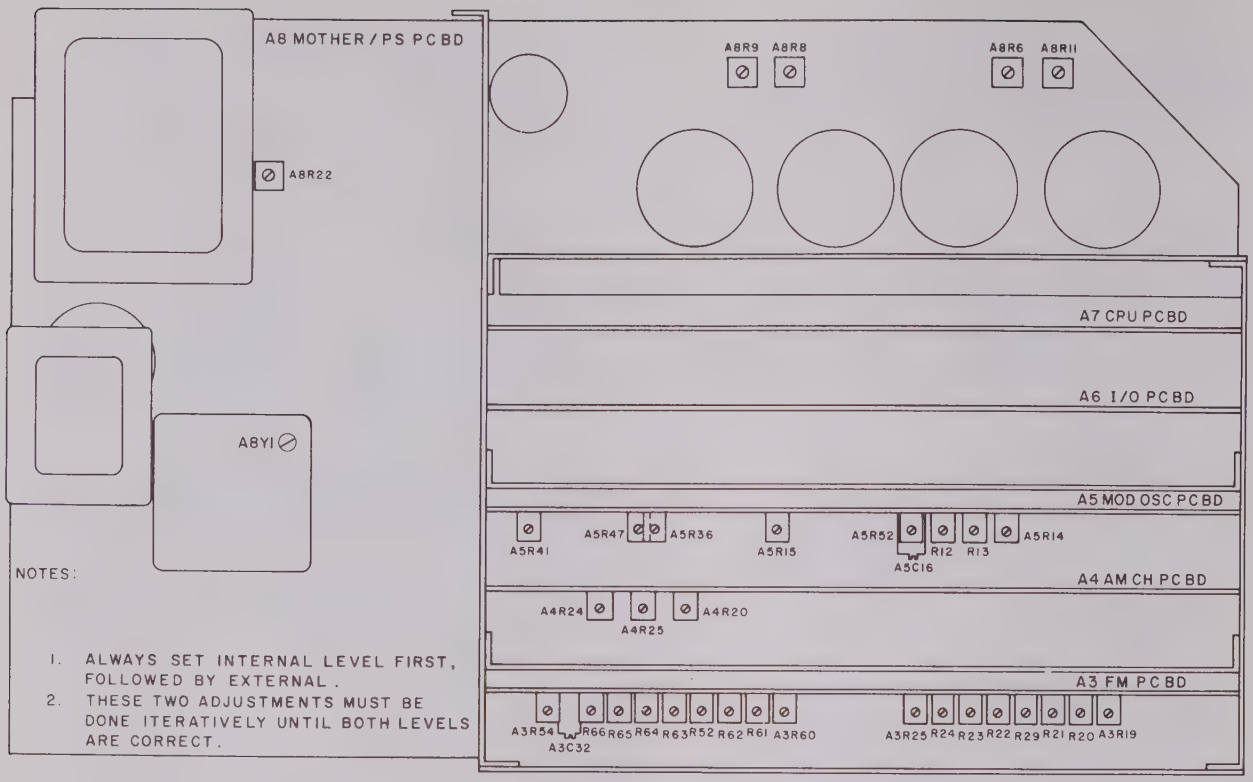
a. Disconnect all power to the instrument and remove the top cover.

b. Set the rear panel line voltage switch to the 120 V position.

c. Verify that the line fuse is the proper value as listed.

d. Set potentiometer A8R22 fully clockwise.

e. Connect a DVM set to read VAC to the variac and connect the variac to a 120 VAC supply. Adjust the variac for 108 VAC.



REF SYM	FUNCTION	GENERATOR SETTING	ADJUST TO
A8R11	+5 V ADJUST	INIT	+5.0V AT XA7-PIN 22
A8R6	-5.2 V ADJUST	INIT	-5.2V AT XA7-PIN 21
A8R8	+15 V ADJUST	INIT	+15.00V AT XA7-PIN 19
A8R9	-15 V ADJUST	INIT	-15.00V AT XA7-PIN 18
A8R22	POWER FAIL TRIP LEVEL	INIT	TRIP AT 108 VAC LINE
A8Y1	10 MHz REFERENCE ADJUST	INIT	10MHz ±0.1Hz AT 10MHz REF IN/OUT CONNECTOR
A1A1C04	OSCILLATOR BAND 0 ADJUST	INIT+FREQ 74.52495 MHz	+50 ± 0.2 VOLTS DC AT JUNCTION A1A1R02 AND A1A1L01
A1A1C14	" 1 "	INIT+FREQ 82.28495 MHz	"
A1A1C24	" 2 "	INIT+FREQ 90.84995 MHz	"
A1A1C34	" 3 "	INIT+FREQ 100.30495 MHz	"
A1A1C44	" 4 "	INIT+FREQ 110.74495 MHz	"
A1A1C54	" 5 "	INIT+FREQ 122.27495 MHz	"
A1A1C64	" 6 "	INIT+FREQ 134.99995 MHz	"
A5R12	FREQ CAL 2.5 - 24.9 kHz	INIT + MOD OSC FREQ 2.5 kHz	2.5kHz ±1Hz AT MOD OSC OUTPUT J4 (COUNTER)
A5C16	FREQ CAL 25 kHz	INIT + MOD OSC FREQ 24.9 kHz	24.9kHz ±10Hz AT MOD OSC OUTPUT J4 (COUNTER)
A5R52	FREQ CAL 25 kHz - 50 kHz	INIT + MOD OSC FREQ 25 kHz	25kHz ± 10Hz AT MOD OSC OUTPUT J4 (COUNTER)
A5R13	FREQ CAL 250 - 2.49 kHz	INIT + MOD OSC FREQ 2.49 kHz	2.49kHz ±1Hz AT MOD OSC OUTPUT J4 (COUNTER)
A5R14	FREQ CAL 20 - 249 Hz	INIT + MOD OSC FREQ 249Hz	249Hz ±0.1Hz AT MOD OSC OUTPUT J4 (COUNTER)
A5R15	INT MOD OSC LEVEL	INIT (1.0kHz)	1.00 ± 0.001 VAC AT A5U4, PIN 3
A5R36	EXT MOD OSC LEVEL	INIT (1.0kHz) 1V	1.00 ± 0.001VAC AT J4 (NOTE 1)
A5R41	EXT MOD OSC D.C. OFFSET	INIT	0 ± 0.005VAC AT J4
A5R47	INT SWEEP LEVEL	INIT + SWP ON + SWP I	2.8 V P-P AT XA5-PIN 13
A4R20	ALC OFFSET CONTROL	INIT + 9.1dBm + RF ON	+9.1 dBm AT RF OUTPUT J1 (NOTE 2)
A4R24	ALC RF GAIN CONTROL	INIT + 13 dBm + RF ON	+13 dBm AT RF OUTPUT J1 (NOTE 2)
A4R25	AM CALIBRATION	INIT + 90% AM + INT AM + RF ON	± 4.5% AM (82AD)
A3R19	FM CAL BAND 0	INIT + 300kHz FM + INT FM + RF ON + FREQ 71.015 MHz	150kHz FM DEV OF RF AT J1 (82AD)
A3R20	" BAND 1	" 78.405 MHz	"
A3R21	" BAND 2	" 86.57 MHz	"
A3R22	" BAND 3	" 95.58 MHz	"
A3R23	" BAND 4	" 105.525 MHz	"
A3R24	" BAND 5	" 116.51 MHz	"
A3R25	" BAND 6	" 128.64 MHz	"
A3R29	PM CALIBRATION	INIT + 16 RAD PM + INT PM + RF ON + MOD FREQ 2.0kHz	32.0kHz DEV, 82AD FILTERS IN 300 Hz - 120 kHz POSN.
A3R52	LIN ADJ	INIT + 300 kHz FM + INT FM	MIN RIPPLE WAVEFORM PEAKS A3U17 - PIN 6 (SCOPE)
A3R54	ZERO ADJ	INIT + 300 kHz FM	UNIPOLAR NEG SINEWAVE PEAKS 0V, A3U17 - PIN 6
A3R60	FM DIST NULL BAND 0	INIT + 300 kHz FM + INT FM + RF ON + FREQ 71.015 MHz	MIN THD (≈.07%)
A3R61	" BAND 1	" 78.405 MHz	
A3R62	" BAND 2	" 86.57 MHz	
A3R63	" BAND 3	" 95.58 MHz	
A3R64	" BAND 4	" 105.525 MHz	
A3R65	" BAND 5	" 116.51 MHz	
A3R66	" BAND 6	" 128.64 MHz	
A3C32	FM FREQ RESPONSE	INIT + EXT FM + 300 kHz FM	1V P-P 10kHz SQ WAVE EXT FM J2, RESP J1. RT ≈ 1μ sec

833122A

Figure 5-1. Adjustment Location and Description.

f. Connect the instrument power cord to the variac and set the instrument POWER ON/STBY switch to ON.

g. Slowly adjust potentiometer A8R22 counterclockwise until the instrument initializes, the display should contain all dashes for approximately three seconds, followed by a normal data display corresponding to the setting of the instrument when it was last shut off.

h. Set the instrument POWER ON/STBY switch to OFF and set the variac for 120 VAC.

i. Set the instrument POWER ON/STBY switch to ON; the display should indicate as specified in step g.

5-43. Power supply voltage adjustments. The power supply voltage adjustments sets the +5, -5.2, +15, and -15 VDC power supply voltages.

5-44. Perform the adjustments as follows:

a. Disconnect power to the instrument and remove the top cover.

b. Adjust the variac for 120 VAC and connect the instrument power cord to the variac.

c. Set the instrument POWER ON/STBY switch to ON.

d. Refer to Table 5-5, use a voltmeter and measure the voltage at each test point and adjust each potentiometer for the specified voltage.

NOTE

Test setups used in the following adjustment and calibration procedures have been stored in the instrument at the factory. If stored test setup data has not been overwritten in the field, instrument setups can be expedited by recalling the stored data. Required test setups can also be entered manually. Both methods are listed in the procedures that follow; use whichever procedure is applicable.

5-45. 10 MHz reference adjustment. The 10 MHz reference adjustment adjusts the accuracy of the 10 MHz crystal.

5-46. Perform the adjustment as follows:

a. Set the instrument POWER ON/STBY switch to ON and allow it to warm up for one hour.

b. Connect the frequency counter to the instrument rear panel 10 MHz REF IN/OUT connector and set the frequency counter to read 10 MHz ±0.1 Hz.

NOTE

If the stored test setup data has not been overwritten, perform step c. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step d.

c. Set the instrument controls as follows:

1. Press PROG RCL , 1 , ENTER

d. Set the instrument controls as follows:

1. AM (OFF)
2. FM (OFF)
3. RF LEVEL (0 dBm)
4. FREQUENCY (10 MHz)
5. RF (ON)

e. Observe the frequency counter and adjust the crystal oscillator A8Y1 on the mother/power supply board A8 for 10 MHz ±0.1 Hz.

TABLE 5-5. Power supply test points, voltages, and adjustments.

Test Point	Voltage	Adjustment
A8AX7, pin 22	+5.0 ±0.02 volts	A8R11
A8AX7, pin 21	-5.2 ±0.02 volts	A8R6
A8AX7, pin 19	+15.0 ±0.02 volts	A8R8
A8AX7, pin 18	-15.0 ±0.02 volts	A8R9

TABLE 5-6. OSCILLATOR FREQUENCIES AND ADJUSTMENTS		
Manual Frequency Selection	Stored Test Setup Selection	Adjustment Control
74.52495 MHz	Press: PROG RCL, 3, ENTER	A1A1C04
82.28495 MHz	Press: PROG RCL, 4, ENTER	A1A1C14
90.84995 MHz	Press: PROG RCL, 5, ENTER	A1A1C24
100.30495 MHz	Press: PROG RCL, 6, ENTER	A1A1C34
110.74495 MHz	Press: PROG RCL, 7, ENTER	A1A1C44
122.27495 MHz	Press: PROG RCL, 8, ENTER	A1A1C54
134.99995 MHz	Press: PROG RCL, 9, ENTER	A1A1C64

5-47. Oscillator adjustments. The oscillator adjustments adjust the dynamic tuning voltage range for each oscillator band.

5-48. Perform the adjustment as follows:

a. Connect a DVM to the junction of resistor A1A1R02 and inductor A1A1L01 located on the oscillator board. Refer to Figure 7-2.

b. Press the instrument FM OFF key.

c. Select each of the output frequencies listed in Table 5-6 in sequence, either manually or by recalling the stored setup and verify that the DVM indicates 50 ±0.2 volts DC for each frequency. If necessary, adjust the listed control to obtain the specified voltage.

d. Select each of the output frequencies listed in Table 5-7 in sequence, either manually or by recalling the stored test setup and verify that the DVM indicates 13 ±2 volts DC for each frequency.

e. Disconnect the DVM from the junction of resistor A1A1R02 and inductor A1A1L01.

5-49. Modulation oscillator adjustments. The modulation oscillator adjustments consist of adjusting the oscillator frequency, output level, and sweep level.

5-50. Set the following initial conditions before performing the modulation oscillator adjustments.

a. Set the instrument POWER ON/STBY switch to STBY.

b. Remove the modulation oscillator board A5 from the instrument.

c. Install the modulation oscillator board on the extender card and plug in the extender card into the A5 slot.

d. Set the instrument POWER ON/STBY switch to ON.

5-51. Frequency adjustments. The frequency adjustments adjust the frequency accuracy of the modulation oscillator four bands.

5-52. Perform the frequency adjustments as follows:

a. Connect the frequency counter channel A input to the instrument front panel MOD OSC OUTPUT connector.

TABLE 5-7. OSCILLATOR FREQUENCIES	
Manual Frequency Selection	Stored Test Setup Selection
67.50000 MHz	Press: PROG RCL, 10, ENTER
74.52500 MHz	Press: PROG RCL, 11, ENTER
82.28500 MHz	Press: PROG RCL, 12, ENTER
90.85000 MHz	Press: PROG RCL, 13, ENTER
100.30500 MHz	Press: PROG RCL, 14, ENTER
110.74500 MHz	Press: PROG RCL, 15, ENTER
122.27500 MHz	Press: PROG RCL, 16, ENTER

TABLE 5-8. MODULATION OSCILLATOR FREQUENCY

Frequency and Level	Stored Test Setup	Adjustment	Specified Frequency
249 Hz 1.0V	Press: PROG RCL, 20, ENTER	A5R14	249 Hz ±0.1 Hz
2.49 kHz 1.0V	Press: PROG RCL, 21, ENTER	A5R13	2.49 kHz ±1 Hz
2.50 kHz 1.0V	Press: PROG RCL, 22, ENTER	A5R12	2.50 kHz ±1 Hz
24.9 kHz 1.0V	Press: PROG RCL, 23, ENTER	A5C16	24.9 kHz ±10 Hz
25.0 kHz 1.0V	Press: PROG RCL, 24, ENTER	A5R52	25.0 kHz ±10 Hz

b. Set the instrument controls as follows:

1. FUNCTION (FREQ A)

2. GATE TIME/DISPLAY (100 ms)

3. LEVEL (PRESET)

4. SLOPE (-)

5. ATTEN (1 M , X10)

6. AC/DC (AC)

7. CHECK/COM A/SEP (SEP)

c. Set tuning capacitor A5C16 on the modulation oscillator board to the fully open (minimum capacity) setting.

d. Set the modulation oscillator frequency and level to each of the values listed in Table 5-8, either manually or by recalling the stored test setups. Adjust the listed control to obtain the specified frequency on the frequency counter.

e. Because of possible interaction between adjustments, repeat step d.

5-53. Output level adjustment. The output level adjustment adjusts the level of the modulation oscillator.

5-54. Perform the adjustment as follows:

a. Set the instrument MOD OSC LEVEL to 0.0 volts, or recall stored test setup 25, (Press: PROG RCL, 25, ENTER).

b. Set the DVM to the 200 mV DC range and connect it to the instrument front panel MOD OSC OUTPUT connector.

c. Observe the DVM and adjust the output zero potentiometer A5R41 on the modulation oscillator board for 0.000 volts ±5 millivolts.

d. Disconnect the DVM.

e. Set the DVM controls as follows:

1. FULL-SCALE RANGE (1.0 volt)

2. FILTER (OUT)

3. DISPLAY (AC volts)

e. Using a shielded cable with alligator clips on one end, connect the low (ground) lead of the DVM to the ground side of resistor A5R10. Connect the high lead of DVM to pin 3 of integrated circuit A5U4.

f. Set the instrument MOD OSC FREQ to 1.0 kHz and the MOD OSC LEVEL to 1.0 volt, or recall stored test setup 26, (Press: PROG RCL, 26, ENTER).

g. Observe the DVM and adjust the oscillator level potentiometer A5R15 for 1.000 volts ±1 millivolt.

5-55. Sweep level adjustment. The sweep level adjustment adjusts the peak-to-peak amplitude of the sweep range.

5-56. Perform the adjustment as follows:

a. Press the instrument SWP and SWP 1 key, or recall stored test setup 27, (Press PROG RCL, 27, ENTER.)

b. Using a 10:1 probe, connect the oscilloscope to pin 13 of the modulation oscillator board edge connector.

c. Observe the oscilloscope and adjust the sweep level potentiometer A5R47 for a 2.8 volts peak-to-peak signal.

d. Set the POWER ON/STBY switch to STBY.

e. Disconnect the oscilloscope probe, remove the extender card, and install the modulation oscillator board in the instrument.

5-57. FM board adjustments. The FM board adjustments consist of adjusting the zero and linearity potentiometers, the modulation and distortion potentiometers, the PM potentiometer, and the rise potentiometer.

5-58. Set the following initial conditions before performing the FM board adjustments.

a. Set the instrument POWER ON/STBY switch to STBY.

b. Remove the FM board A3 from the instrument.

c. Install the FM board on the extender card and plug in the extender card into the A3 slot.

d. Set the instrument POWER ON/STBY switch to ON.

e. Connect the instrument front panel RF OUT connector to the modulation meter RF input jack.

f. Set the modulation meter controls as follows:

1. TUNING (AUTO)

2. HP (30 Hz)

3. LP (15 kHz)

4. PEAK ($\frac{PK-PK}{2}$)

5. RANGE (300 kHz)

6. FUNCTION (kHz DEVIATION)

g. Connect the modulation meter AF OUTPUT connector to the audio analyzer high-level INPUT connector.

h. Set the audio analyzer for DISTN measurement, with the 80 kHz low-pass filter.

NOTE

If the stored test setup has not been overwritten, perform step i. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step j.

i. Set the instrument controls as follows:

1. Press PROG RCL , 28 , ENTER

j. Set the instrument controls as follows:

1. FREQUENCY (100.00000 MHz)

2. OUTPUT LEVEL (OUTPUT LEVEL 0.0 dBm)

3. FM DEVIATION (300 kHz)

4. MOD. FREQUENCY (1.0 kHz)

5. INTERNAL SOURCE (OFF)

5-59. Linearity and zero adjustments. The linearity and zero adjustment corrects for non-linearity in the 2X multiplier circuit.

5-60. Perform the adjustment as follows:

a. Using the 10:1 probe, connect the oscilloscope to pin 6 of integrated circuit A3U17 located on the FM board A3.

b. Observe the oscilloscope and adjust the zero potentiometer A3R54 for a 0 volt DC level.

c. Press the instrument FM INT key, or recall stored test setup 29, (Press: PROG RCL, 29, ENTER).

d. Observe the oscilloscope and adjust the linearity potentiometer A3R52 for the most uniform waveform (i.e., minimum amplitude difference). Refer to Figure 5-2.

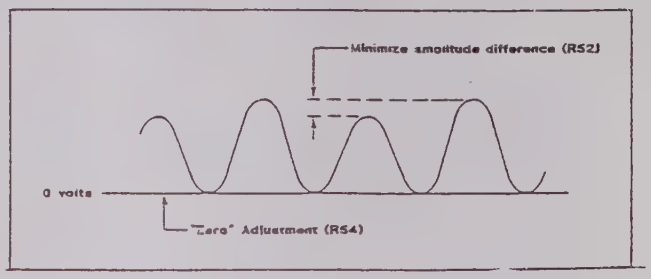


Figure 5-2. Linearity and Zero Adjustment Waveform.

e. Repeat steps b. through d. until both adjustments are within specifications.

5-61. Modulation and distortion adjustments. The modulation and distortion adjustments adjust the accuracy of the frequency modulation and nulls the 2nd harmonic component in the FM processor.

5-62. Perform the adjustment as follows:

a. Set the instrument output frequency to each of the values listed in Table 5-9, either manually or by recalling the stored test setups. Observe the modulation meter and audio analyzer and adjust the listed control to the specifications as listed in Table 5-9.

5-63. PM adjustments. The PM adjustments adjust the accuracy of the phase modulation.

NOTE

If the stored test setup has not been overwritten, perform step a. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step b.

a. Set the instrument controls as follows:

1. Press: PROG RCL , 37 , ENTER

b. Set the instrument controls as follows:

1. FREQUENCY (100.00000 MHz)

TABLE 5-9. FM BOARD MODULATION AND DISTORTION ADJUSTMENTS AND SPECIFICATIONS

Manual Freq Setting	Stored Test Setup Selection	Adjustment Control	Specifications
71.015 MHz	Press: PROG RCL, 30, ENTER	A3R19 A3R60	150 ±0 kHz <0.06% distortion
78.405 MHz	Press: PROG RCL, 31, ENTER	A3R20 A3R61	150 ±0 kHz <0.06% distortion
86.570 MHz	Press: PROG RCL, 32, ENTER	A3R21 A3R62	150 ±0 kHz <0.06% distortion
95.580 MHz	Press: PROG RCL, 33, ENTER	A3R22 A3R63	150 ±0 kHz <0.06% distortion
105.525 MHz	Press: PROG RCL, 34, ENTER	A3R23 A3R64	150 ±0 kHz <0.06% distortion
116.510 MHz	Press: PROG RCL, 35, ENTER	A3R24 A3R65	150 ±0 kHz <0.06% distortion
128.640 MHz	Press: PROG RCL, 36, ENTER	A3R25 A3R66	150 ±0 kHz <0.06% distortion

2. PM DEVIATION (16 RADIANS)

3. PM INT (ON)

4. MOD OSC FREQ (2.0 kHz)

5. RF OUTPUT LEVEL (0.0 dBm)

c. Set the modulation meter controls as follows:

1. TUNING (AUTO)

2. HP (30 Hz)

3. LP (120 kHz)

4. PEAK $\left(\frac{PK\text{-}PK}{2}\right)$

5. RANGE (100 kHz)

6. FUNCTION (kHz DEVIATION)

d. Observe the modulation meter and adjust the PM calibration potentiometer A3R29 for exactly 32.0 kHz deviation.

5-64. AM Board Adjustments. The AM board adjustments consist of adjusting the attenuator offset and gain potentiometer and the % AM potentiometer.

5-65. Perform the attenuator adjustments as follows:

a. Connect the sensor of the RF microwattmeter to the instrument front panel RF OUT connector.

b. Set the RF microwattmeter controls as follows:

1. MODE (dB)

2. RANGE (AUTO)

3. CHANNEL (Channel number)

4. SENSOR (Sensor number)

NOTE

If the stored test setup has not been overwritten, perform step c. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step d.

c. Set the instrument controls as follows:

1. Press: PROG RCL , 39 , ENTER

d. Set the instrument controls as follows:

1. FREQUENCY (100.00000 MHz)

2. OUTPUT LEVEL (9.1 dBm)

3. AM (OFF)

4. FM (OFF)

e. Observe the RF microwattmeter and adjust offset potentiometer A4R20 for 9.1 dBm.

NOTE

If the stored test setup has not been overwritten, perform step f. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step g.

f. Set the instrument controls as follows:

1. Press: PROG RCL , 40 , ENTER

g. Set the instrument controls as follows:

1. FREQUENCY (100.00000 MHz)

2. OUTPUT LEVEL (13.0 dBm)

3. AM (OFF)

4. FM (OFF)

h. Observe the RF microwattmeter and adjust gain potentiometer A4R24 for 13.0 dBm.

i. Repeat steps c. through g. until both adjustments are within specifications.

5-66. AM modulation adjustment. The AM adjustment adjusts the absolute accuracy of AM modulation.

5-67. Perform the adjustment as follows:

a. Connect the modulation meter RF INPUT connector to the instrument RF OUT connector.

b. Connect the modulation meter AF OUTPUT connector to the audio analyzer HIGH INPUT.

c. Set the audio analyzer controls as follows:

1. Press: DISTORTION

2. TUNING (AUTO)

3. HP (30 Hz)

4. LP (15 kHz)

5. PEAK $\frac{(PK-PK)}{2}$

6. RANGE (100 kHz)

7. FUNCTION (AM %)

NOTE

If the stored test setup has not been overwritten, perform step d. If the stored test setup data has been overwritten or fails to provide the proper setup, perform step e.

d. Set the instrument controls as follows:

1. Press: PROG RCL , 41 , ENTER

e. Set the instrument controls as follows:

1. FREQUENCY (100.00000 MHz)

2. OUTPUT LEVEL (16.0 dBm)

3. FM (OFF)

4. MOD OSC FREQ (1kHz)

5. MOD OSC LEVEL (1V)

6. AM (90%)

7. AM INT (ON)

8. RF (ON)

f. The modulation meter should read 90 ±4.5% AM.

g. Set the instrument controls as follows:

1. Press: PROG RCL , 42 , ENTER

h. Manually set the instrument OUTPUT LEVEL to 12.1 dBm.

i. Observe the modulation meter and adjust potentiometer A4R25 for 90 ±4.5% AM.

j. Repeat steps d. through i. until the AM % reading is 90 ±4.5%.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. Table 6-2. Replaceable Parts, list all the replaceable parts and includes; the reference symbol, description, Mfr., Mfr's Part No., and the BEC Part No. Table 6-1. Manufacturer's Federal Supply Code Numbers, list the manufacturers federal supply numbers.

TABLE 6-1. MANUFACTURER"S FEDERAL SUPPLY CODE NUMBERS.

NUMBER	NAME
00213	Nytronics
00241	Fenwal Electronics
00853	Sangmo Electric Co
01121	Allen Bradley
01139	General Electric
01295	Texas Instruments
02114	Ferroxcube Corp
02660	Amphenol
02735	RCA
02749	Budd Radio
03888	KDI - Pyrofilm
03911	Clairex
04213	Cadell - Burns
04222	AVX
04713	Motorola Semiconductor
04901	Boonton Electronics
04963	Minnesota Mining (3M)
05245	Corcom
06383	Panduit Corp
06540	Amatom - Division of Mite
06665	Precision Monolithics
06776	Robinson Nugent
06915	Richo Plastic
07047	Milton Ross Co
07263	Fairchild Semiconductor
07933	Raytheon
08077	International Rectifier
08540	General Cement - GC Electronics
08779	Signal Transformer
10236	Tally Industries
11961	Semicon
13254	Brady
13812	Amperex Electronics - Dialco
14557	Stanley Hardware
14655	Cornell - Dublier
14752	Electro Cube Inc
15281	General Instrument
15542	Mini - Circuits
15636	Elec - Trol
15686	Disc Industries
15912	T & B Ansley
16482	Belden
16546	Centralab
16733	Cablewaves
17117	Electronic Molding
17801	Panel Corp - Schurter
18178	Vactec
18324	Signectics Corp
19505	Applied Engineering Prod
19701	Mepco Electra
20307	Arco - Micronics
21455	Parametric Industries
21604	Buckeye Stamping
22859	Flex Products
23050	Product Components
24226	Gowanda Electronics
24931	Specialty Connector
26863	All States Plastics
27014	National Semiconductor
27264	Molex Inc
27735	F-Dyne Electronics
27777	Varo Semiconductors
28480	Hewlett Packard
29907	Omega
31781	EDAC
31827	Budwig
31918	ITT Schadow Inc
31935	Siemens
32575	AMP
32897	Erie
32997	Bourns Inc - Trimpot
33062	Ferronics
33297	NEC
33883	RMC
34335	Advanced Micro Devices
34371	Harris Semiconductor
34430	Monsanto
34482	Acme
34641	Instrument Specialties
34649	Intel Corp
46384	Penn Engineering
50088	Mostek
50316	Mini - Systems
50501	Crown Microwave
51167	Aries
51406	Murata Corp of America
51604	Analog Devices
52464	OKI
52653	Birtcher
52750	Alan
53507	Robleyco
53894	Aham
53919	Pasternack
53946	CW Industries
54420	Dage
54426	Buss Fuses
56048	Associated Spring
56289	Sprague Electric
56708	Zilog
57582	Kahgan
59474	Jeffers Electronics
61637	Kemet - Union Carbide
70485	Atlantic India Rubber
71279	Cambion - Cambridge Thermonics
71450	CTS Corp
72962	ESNA
73138	Beckman Instruments Inc - Helipot Div
73899	JFD
73957	Groov - Pin
74970	E.F. Johnson
75915	Littlefuse
77900	Shakeproof
78277	Sigma
79963	Zierick
81073	Grayhill
82389	Switchcraft
83330	H.H. Smith
84830	Lee Spring
86026	CTC
90372	Wakefield
91168	El Menco
91268	Johanson
91418	P.R. Mallory
91506	Augat
93306	Uniform Tubes
95077	Solitron Microwave
95146	Alco
95402	Electro Dynamics
95712	Bendix Corp - Dage Elec Div
95987	Weckesser
98291	Sealectro Co
S4217	United Chemcon
5F520	Panel Components

Replaceable Parts List for Oscillator Housing Assembly PL 102408-01C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
A1A1	PWA Oscillator	04901	BEC	102409-01D
A1A2	PWA Low Noise PS	04901	BEC	102410-01D
FL1	Line Filter Assembly	04901	BEC	102452-01B
FL2	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL3	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL4	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL5	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL6	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL7	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL8	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL9	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL10	Filter Feedthru 1500 pF	32897	1212-024	439006-000
J5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
W1	Cable Unit Oscillator Housing	04901	BEC	572089-00A
W2	Cable Unit Oscillator Housing	04901	BEC	572090-00A
W3	Cable Unit Oscillator Housing	04901	BEC	572088-00A
W4	Cable Unit Oscillator Housing	04901	BEC	572087-00A
W5	Cable Harness Oscillator Housing	04901	BEC	569196-00A

Replaceable Parts List for Cable Harness Oscillator Housing PL 569196-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
P1	Connector 5 Circuit	06383	CE156F24-5-C	479394-000
P2	Connector 5 Circuit	06383	CE156F24-5-C	479394-000
P3	Connector 5 Circuit	06383	CE156F24-5-C	479394-000

Replaceable Parts List for PWA Oscillator PL 102409-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C01	Capacitor Cer Chip 75 pF 5% 500V	73899	MA20-750J	224356-000
C1	Capacitor Cer Chip 4700 pF 10% 50V	61637	C1210C472K5XAH	224341-000
C02	Capacitor Cer Chip 15 pF 5% 500V	73899	MA20-220J	224352-000
C2	Capacitor Cer Chip 4700 pF 10% 50V	61637	C1210C472K5XAH	224341-000
C03	Capacitor Cer Chip 13 pF 5% 500V	73899	MA20-130J	224351-000
C3	Capacitor Cer Chip 4700 pF 10% 50V	61637	C1210C472K5XAH	224341-000
C04	Capacitor Var 1.9-15.7 pF	74970	187-0109-005	275156-000
C05	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C06	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C07	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C08	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
C11	Capacitor Cer Chip 75 pF 5% 500V	73899	MA20-750J	224356-000
C12	Capacitor Cer Chip 15 pF 5% 500V	73899	MA20-220J	224352-000
C13	Capacitor Cer Chip 11 pF 5% 500V	73899	MA20-110J	224350-000
C14	Capacitor Var 1.9-15.7 pF	74970	187-0109-005	275156-000
C15	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C16	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C17	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C18	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
C21	Capacitor Cer Chip 75 pF 5% 500V	73899	MA20-750J	224356-000
C22	Capacitor Cer Chip 9.1 pF ±0.25 pF 500V	73899	MA20-9R1C	224362-000
C23	Capacitor Cer Chip 8.2 pF ±0.25 pF 500V	73899	MA20-8R2C	224348-000
C24	Capacitor Var 1.7-11 pF	74970	187-0106-005	275155-000
C25	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C26	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C27	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C28	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
C31	Capacitor Cer Chip 56 pF 5% 500V	73899	MA20-560J	224355-000
C32	Capacitor Cer Chip 8.2 pF ±0.25 pF 500V	73899	MA20-8R2C	224348-000
C33	Capacitor Cer Chip 7.5 pF ±0.25 pF 500V	73899	MA20-7R5C	224361-000
C34	Capacitor Var 1.7-11 pF	74970	187-0106-005	275155-000
C35	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C36	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C37	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C38	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
C41	Capacitor Cer Chip 56 pF 5% 500V	73899	MA20-560J	224355-000
C42	Capacitor Cer Chip 8.2 pF ±0.25 pF 500V	73899	MA20-8R2C	224348-000
C43	Capacitor Cer Chip 6.8 pF ±0.25 pF 500V	73899	MA20-6R8C	224347-000
C44	Capacitor Var 1.7-11 pF	74970	187-0106-005	275155-000
C45	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C46	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C47	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C48	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
C51	Capacitor Cer Chip 47 pF 5% 500V	73899	MA20-470J	224358-000
C52	Capacitor Cer Chip 6.2 pF ±0.25 pF 500V	73899	MA20-6R2C	224346-000
C53	Capacitor Cer Chip 5.1 pF ±0.25 pF 500V	73899	MA20-5R1C	224360-000
C54	Capacitor Var 1.7-11 pF	74970	187-0106-005	275155-000
C55	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C56	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C57	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C58	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA Oscillator PL 102409-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C61	Capacitor Cer Chip 47 pF 5% 500V	73899	MA20-470J	224358-000
C62	Capacitor Cer Chip 5.1 pF ±0.25 pF 500V	73899	MA20-5R1C	224360-000
C63	Capacitor Cer Chip 4.3 pF ±0.25 pF 500V	73899	MA20-4R3C	224345-000
C64	Capacitor Var 1.3-5.4 pF	74970	187-0103-005	275154-000
C65	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C66	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C67	Capacitor Cer 0.001 µF 10% 100V	04222	SR151C102KAA	224270-000
C68	Capacitor Cer Chip 100 pF 5% 500V	73899	MA20-101J	224357-000
CR01	Diode 1N5147A	04713	1N5147A	530767-000
CR02	Diode 5082-3188	28480	HP5082-3188	530165-000
CR03	Diode 1N5148A	04713	1N5148A	530768-000
CR04	Diode FD700	07263	FD700	530166-000
CR05	Diode 5082-2800	28480	5082-2800	530122-000
CR06	Diode 1N914	01295	1N914	530058-000
CR11	Diode 1N5146A	04713	1N5146A	530766-000
CR12	Diode 5082-3188	28480	HP5082-3188	530165-000
CR13	Diode 1N5147A	04713	1N5147A	530767-000
CR14	Diode FD700	07263	FD700	530166-000
CR15	Diode 5082-2800	28480	5082-2800	530122-000
CR16	Diode 1N914	01295	1N914	530058-000
CR21	Diode 1N5146A	04713	1N5146A	530766-000
CR22	Diode 5082-3188	28480	HP5082-3188	530165-000
CR23	Diode 1N5146A	04713	1N5146A	530766-000
CR24	Diode FD700	07263	FD700	530166-000
CR25	Diode 5082-2800	28480	5082-2800	530122-000
CR26	Diode 1N914	01295	1N914	530058-000
CR31	Diode 1N5145A	04713	1N5145A	530765-000
CR32	Diode 5082-3188	28480	HP5082-3188	530165-000
CR33	Diode 1N5146A	04713	1N5146A	530766-000
CR34	Diode FD700	07263	FD700	530166-000
CR35	Diode 5082-2800	28480	5082-2800	530122-000
CR36	Diode 1N914	01295	1N914	530058-000
CR41	Diode 1N5144A	04713	1N5144A	530764-000
CR42	Diode 5082-3188	28480	HP5082-3188	530165-000
CR43	Diode 1N5145A	04713	1N5145A	530765-000
CR44	Diode FD700	07263	FD700	530166-000
CR45	Diode 5082-2800	28480	5082-2800	530122-000
CR46	Diode 1N914	01295	1N914	530058-000
CR51	Diode 1N5144A	04713	1N5144A	530764-000
CR52	Diode 5082-3188	28480	HP5082-3188	530165-000
CR53	Diode 1N5145A	04713	1N5145A	530765-000
CR54	Diode FD700	07263	FD700	530166-000
CR55	Diode 5082-2800	28480	5082-2800	530122-000
CR56	Diode 1N914	01295	1N914	530058-000
CR61	Diode 1N5143A	04713	1N5143A	530763-000
CR62	Diode 5082-3188	28480	HP5082-3188	530165-000
CR63	Diode 1N5144A	04713	1N5144A	530764-000
CR64	Diode FD700	07263	FD700	530166-000
CR65	Diode 5082-2800	28480	5082-2800	530122-000
CR66	Diode 1N914	01295	1N914	530058-000
J1	Connector Coaxial SMB	19505	209	477317-000
J2	Connector Coaxial SMB	19505	209	477317-000
J3	Connector Coaxial SMB	19505	209	477317-000
J4	Connector Coaxial SMB	19505	209	477317-000
J5	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
J6	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
L1	Inductor 1.0 µH 10%	24226	10/101	400369-000
L2	Inductor 1.2 µH 10%	24226	10/121	400390-000
L11	Inductor 1.5 µH 10%	24226	10/151	400383-000
L12	Inductor 1.5 µH 10%	24226	10/151	400383-000
L13	Inductor 1.5 µH 10%	24226	10/151	400383-000
L14	Inductor 1.5 µH 10%	24226	10/151	400383-000
L15	Inductor 1.5 µH 10%	24226	10/151	400383-000
L21	Inductor 1.2 µH 10%	24226	10/121	400390-000
L22	Inductor 1.2 µH 10%	24226	10/121	400390-000
L23	Inductor 1.2 µH 10%	24226	10/121	400390-000
L24	Inductor 1.2 µH 10%	24226	10/121	400390-000
L25	Inductor 1.2 µH 10%	24226	10/121	400390-000
L31	Inductor 1.2 µH 10%	24226	10/121	400390-000
L32	Inductor 1.2 µH 10%	24226	10/121	400390-000
L33	Inductor 1.2 µH 10%	24226	10/121	400390-000
L34	Inductor 1.2 µH 10%	24226	10/121	400390-000
L35	Inductor 1.2 µH 10%	24226	10/121	400390-000
L41	Inductor 1.0 µH 10%	24226	10/101	400369-000
L42	Inductor 1.0 µH 10%	24226	10/101	400369-000
L43	Inductor 1.0 µH 10%	24226	10/101	400369-000
L44	Inductor 1.0 µH 10%	24226	10/101	400369-000
L45	Inductor 1.0 µH 10%	24226	10/101	400369-000
L51	Inductor 1.0 µH 10%	24226	10/101	400369-000
L52	Inductor 1.0 µH 10%	24226	10/101	400369-000
L53	Inductor 1.0 µH 10%	24226	10/101	400369-000

Replaceable Parts List for PWA Oscillator PL 102409-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
L54	Inductor 1.0 µH 10%	24226	10/101	400369-000
L55	Inductor 1.0 µH 10%	24226	10/101	400369-000
L61	Inductor 1.0 µH 10%	24226	10/101	400369-000
L62	Inductor 1.0 µH 10%	24226	10/101	400369-000
L63	Inductor 1.0 µH 10%	24226	10/101	400369-000
L64	Inductor 1.0 µH 10%	24226	10/101	400369-000
L65	Inductor 1.0 µH 10%	24226	10/101	400369-000
L01	Inductor 1.5 µH 10%	24226	10/151	400383-000
L02	Inductor 1.5 µH 10%	24226	10/151	400383-000
L03	Inductor 1.5 µH 10%	24226	10/151	400383-000
L04	Inductor 1.5 µH 10%	24226	10/151	400383-000
L05	Inductor 1.5 µH 10%	24226	10/151	400383-000
Q01	Transistor 2N5397	01295	2N5397	528138-000
Q11	Transistor 2N5397	01295	2N5397	528138-000
Q21	Transistor 2N5397	01295	2N5397	528138-000
Q31	Transistor 2N5397	01295	2N5397	528138-000
Q41	Transistor 2N5397	01295	2N5397	528138-000
Q51	Transistor 2N5397	01295	2N5397	528138-000
Q61	Transistor 2N5397	01295	2N5397	528138-000
R02	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R03	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R04	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R4	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R05	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R06	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R11	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R12	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R13	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R14	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R15	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R16	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R21	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R22	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R23	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R24	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R25	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R26	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R31	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R32	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R33	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R34	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R35	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R36	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R41	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R42	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R43	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R44	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R45	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R46	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R51	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R52	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R53	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R54	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R55	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R56	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R62	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R63	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R64	Resistor MF 750 ohm 1%	---	RN55D-7500-F	341284-000
R65	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R66	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
T1	Transformer RF M/F 805038	04901	BEC	410091-01B
U1	IC GPD463 Op Amp	27014	GPD463	535030-000

Replaceable Parts List for RF Housing Assembly PL 103209-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
A2A1	PWA Phase Lock Counter	04901	BEC	102418-01E
A2A7	Counter Cavity Cover Assembly	04901	BEC	102414-01C
AR1	Amplifier Wide Band	04901	BEC	421032-000
FL1	Filter Feedthru (Alternate 439007)	04901	BEC	439003-00C
FL2	Filter Feedthru (Alternate 439007)	04901	BEC	439003-00C
FL3	Filter Feedthru (Alternate 439007)	04901	BEC	439003-00C
FL4	Filter Feedthru (Alternate 439007)	04901	BEC	439003-00C
FL6	Line Filter Assembly	04901	BEC	102452-01B
FL7	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL8	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL9	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL10	Filter Feedthru 1500 pF	32897	1212-024	439006-000
FL11	Filter Feedthru 1500 pF	32897	1212-024	439006-000
J3	Connector Bulkhead	98291	50-675-0000-310	481016-000
J4	Connector Bulkhead	98291	50-675-0000-310	481016-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for RF Housing Assembly PL 103209-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
W1	Cable Assembly Jumper Harness	04901	BEC	571180-00A
W2	Cable Assembly RF Housing Jumper Harness	04901	BEC	571181-00A
W3	Cable Unit RF IN	04901	BEC	572166-00A
W4	Cable Unit 10 MHz IN	04901	BEC	572167-00A
W5	Cable Unit AM IN	04901	BEC	572168-00A
W10	Cable Unit (Phaselock)	04901	BEC	572065-00A
W11	Cable Unit (Phaselock)	04901	BEC	572064-00A
W12	Cable Unit (Phaselock to Counter Cavity)	04901	BEC	920063-00A
W13	Cable Unit (Phaselock to Counter Cavity)	04901	BEC	920063-00A
W14	Cable Unit (Phaselock)	04901	BEC	572066-00A
W15	Cable Assy (Phaselock PC to Power Cable)	04901	BEC	571172-00A

Replaceable Parts List for PWA Low Noise PS PL 102410-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C2	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C3	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C4	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C5	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
CR1	Diode Zener 1N5242B 12V	04713	1N5242B	530146-000
J1	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
L2	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
Q1	Transistor PNP 2N3906	04713	2N3906	528076-000
Q2	Transistor PNP 2N5194	04173	PNP 2N5194	528137-000
R1	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R2	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R3	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R4	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R5	Resistor MF 12.1k ohm 1%	---	RN55D-1212-F	341408-000
U1	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U2	IC AD581JH Volt Ref	51640	AD581JH	535053-000
XU1	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU2	Socket Transistor 3 Pin	07047	90363-202	473046-000

Replaceable Parts List for Cable Harness RF Housing PL 569197-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
FL5	Filter CAN	32897	1212-502	439005-000
P1	Connector Shell 5 Circuit	27264	22-01-2051	479377-000
P2	Connector Shell 5 Circuit	27264	22-01-2051	479377-000
P3	Connector 9 Circuit	27264	22-01-2091	479392-000
P4	Connector Shell 5 Circuit	27264	22-01-2051	479377-000
P5	Connector Shell 5 Circuit	27264	22-01-2051	479377-000
P6	Connector 9 Circuit	27264	22-01-2091	479392-000
P7	Connector Shell 6 Circuit	27264	22-01-2061	479376-000
P8	Connector Shell 6 Circuit	27264	22-01-2061	479376-000
P9	Connector Shell 6 Circuit	27264	22-01-2061	479376-000

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C2	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C3	Capacitor Mica 82 pF 5% 300V	20307	DM5-EC820J	205016-000
C4	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C5	Capacitor Mica 220 pF 5% 50V	20307	DM5-FY221J	205012-000
C6	Capacitor Mica 82 pF 5% 300V	20307	DM5-EC820J	205016-000
C7	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C8	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C9	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C10	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C11	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C12	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C13	Capacitor Mica 82 pF 5% 300V	20307	DM5-EC820J	205016-000
C14	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C15	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C16	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C17	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C18	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C19	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C20	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C21	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C22	Capacitor Mica 22 pF 5% 300V	20307	DM5-CC220J	205036-000
C23	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000
C24	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000
C25	Capacitor Mica 22 pF 5% 300V	20307	DM5-CC220J	205036-000
C26	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C27	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C28	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C29	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C30	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C31	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000
C32	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C33	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C34	Capacitor Mica 75 pF 5% 300V	20307	DM5-EC750J	205043-000
C35	Capacitor Mica 75 pF 5% 300V	20307	DM5-EC750J	205043-000
C36	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C37	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C38	Capacitor Mica 75 pF 5% 300V	20307	DM5-EC750J	205043-000
C39	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C40	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C41	Capacitor Mica 75 pF 5% 300V	20307	DM5-EC750J	205043-000
C42	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C43	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C44	Capacitor Mica 150 pF 5% 100V	20307	DM5-FA151J	205009-000
C45	Capacitor Mica 150 pF 5% 100V	20307	DM5-FA151J	205009-000
C46	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C47	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C48	Capacitor Mica 150 pF 5% 100V	20307	DM5-FA151J	205009-000
C49	Capacitor Mica 220 pF 5% 50V	20307	DM5-FY221J	205012-000
C50	Capacitor Mica 220 pF 5% 50V	20307	DM5-FY221J	205012-000
C51	Capacitor Mica 150 pF 5% 100V	20307	DM5-FA151J	205009-000
C52	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C53	Capacitor Mica 220 pF 5% 50V	20307	DM5-FY221J	205012-000
C54	Capacitor Mica 330 pF 5% 50V	20307	DM5-FY331J	205029-000
C55	Capacitor Mica 330 pF 5% 50V	20307	DM5-FY331J	205029-000
C56	Capacitor Mica 220 pF 5% 50V	20307	DM5-FY221J	205012-000
C57	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C58	Capacitor Mica 300 pF 5% 50V	20307	DM5-FY301J	205026-000
C59	Capacitor Mica 470 pF 5% 300V	20307	DM15-471J	200028-000
C60	Capacitor Mica 470 pF 5% 300V	20307	DM15-471J	200028-000
C61	Capacitor Mica 300 pF 5% 50V	20307	DM5-FY301J	205026-000
C62	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C63	Capacitor Mica 430 pF 5% 500V	57582	DM-15	200130-000
C64	Capacitor Mica 680 pF 5% 300V	20307	DM15-681J	200112-000
C65	Capacitor Mica 680 pF 5% 300V	20307	DM15-681J	200112-000
C66	Capacitor Mica 430 pF 5% 500V	57582	DM-15	200130-000
C67	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C68	Capacitor Mica 620 pF 5% 300V	20307	DM15-621J	200026-000
C69	Capacitor Mica 910 pF 5% 100V	14655	CD15FA911J-03	200125-000
C70	Capacitor Mica 910 pF 5% 100V	14655	CD15FA911J-03	200125-000
C71	Capacitor Mica 620 pF 5% 300V	20307	DM15-621J	200026-000
C72	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C73	Capacitor Mica 910 pF 5% 100V	14655	CD15FA911J-03	200125-000
C74	Capacitor Cer 1500 pF 10% 100V	61637	C052C152K1X5CA	224294-000
C75	Capacitor Cer 1500 pF 10% 100V	61637	C052C152K1X5CA	224294-000
C76	Capacitor Mica 910 pF 5% 100V	14655	CD15FA911J-03	200125-000
C77	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C78	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C79	Capacitor Cer 1500 pF 10% 100V	61637	C052C152K1X5CA	224294-000
C80	Capacitor Cer 1800 pF 10% 100V	61637	C052C182K1X5CA	224373-000
C81	Capacitor Cer 1800 pF 10% 100V	61637	C052C182K1X5CA	224373-000
C82	Capacitor Cer 1500 pF 10% 100V	61637	C052C152K1X5CA	224294-000
C83	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C84	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C85	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C86	Capacitor Cer 2200 pF 10% 100V	61637	C052C222K1X5CA (MIL CK05)	224295-000
C87	Capacitor Cer 2700 pF 10% 100V	61637	C052C272K1X5CA (MIL CK05)	224318-000
C88	Capacitor Cer 2700 pF 10% 100V	61637	C052C272K1X5CA (MIL CK05)	224318-000
C89	Capacitor Cer 2200 pF 10% 100V	61637	C052C222K1X5CA (MIL CK05)	224295-000
C90	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C91	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C92	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C93	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C94	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C95	Capacitor Mica 150 pF 5% 100V	20307	DM5-FA151J	205009-000
C96	Capacitor Mica 390 pF 5% 50V	20307	DM5-FY391J	205028-000
C97	Capacitor Mica 270 pF 5% 50V	91168	DM5-FY271J	205045-000
C98	Capacitor Mica 680 pF 5% 300V	20307	DM15-681J	200112-000
C99	Capacitor Mica 680 pF 5% 300V	20307	DM15-681J	200112-000
C100	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C101	Capacitor Mica 270 pF 5% 50V	91168	DM5-FY271J	205045-000
C102	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C103	Capacitor Mica 390 pF 5% 50V	20307	DM5-FY391J	205028-000
C105	Capacitor Mica 820 pF 5% 300V	20307	DM15-821J	200110-000
C106	Capacitor Cer 1800 pF 10% 100V	61637	C052C182K1X5CA	224373-000
C107	Capacitor Mica 470 pF 5% 300V	20307	DM15-471J	200028-000
C108	Capacitor Mica 820 pF 5% 300V	20307	DM15-821J	200110-000
C109	Capacitor Cer 2700 pF 10% 100V	61637	C052C272K1X5CA (MIL CK05)	224318-000
C110	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C111	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C112	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C113	Capacitor Mica 470 pF 5% 300V	20307	DM15-471J	200028-000
C114	Capacitor Cer 2700 pF 10% 100V	61637	C052C272K1X5CA (MIL CK05)	224318-000
C115	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C116	Capacitor Cer 1800 pF 10% 100V	61637	C052C182K1X5CA	224373-000
C117	Capacitor Mica 270 pF 5% 50V	91168	DM5-FY271J	205045-000
C118	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C119	Capacitor Mica 270 pF 5% 50V	91168	DM5-FY271J	205045-000
C120	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C121	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C122	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C123	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C124	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C125	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C126	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C127	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C128	Capacitor Cer 0.015 µF 10% 50V	04222	MR055C153KAA (Mil CK05)	224342-000
C129	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C130	Capacitor Cer 2200 pF 10% 100V	61637	C052C222K1X5CA (MIL CK05)	224295-000
C131	Capacitor Cer 2200 pF 10% 100V	61637	C052C222K1X5CA (MIL CK05)	224295-000
C132	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C133	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C134	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C135	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C136	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C137	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C138	Capacitor Cer Chip 470 pF 10% 50V	61637	C1210C471K5XAH	224340-000
C139	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C140	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C141	Capacitor Cer Chip 68 pF 10% 50V	61637	C1210C680K6GAH	224335-000
C142	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C143	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C144	Capacitor Cer Chip 0.1 µF 10% 50V	61637	C1210C104K5XAH	224136-000
C145	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C146	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C147	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C148	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C149	Capacitor Mica 2700 pF 5% 500V	20307	DM19-272J	200517-000
C150	Capacitor Cer 0.1 µF 10% 50V	61637	C052C104K5X5CA (MIL CK05)	224287-000
C151	Capacitor Mica 270 pF 5% 50V	91168	DM5-FY271J	205045-000
C152	Capacitor Mica 27 pF 5% 300V	20307	DM5-EC270J	205008-000
CR1	Diode 5082-3188	28480	HP5082-3188	530165-000
CR2	Diode 5082-3188	28480	HP5082-3188	530165-000
CR3	Diode 5082-3188	28480	HP5082-3188	530165-000
CR4	Diode 5082-3188	28480	HP5082-3188	530165-000
CR5	Diode 5082-3188	28480	HP5082-3188	530165-000
CR6	Diode 5082-3188	28480	HP5082-3188	530165-000
CR7	Diode 5082-3188	28480	HP5082-3188	530165-000
CR8	Diode 5082-3188	28480	HP5082-3188	530165-000
CR9	Diode 5082-3188	28480	HP5082-3188	530165-000
CR10	Diode 5082-3188	28480	HP5082-3188	530165-000
CR11	Diode 5082-3188	28480	HP5082-3188	530165-000
CR12	Diode 5082-3188	28480	HP5082-3188	530165-000
CR13	Diode 5082-3188	28480	HP5082-3188	530165-000
CR14	Diode 5082-3188	28480	HP5082-3188	530165-000
CR15	Diode 5082-3188	28480	HP5082-3188	530165-000
CR16	Diode 5082-3188	28480	HP5082-3188	530165-000
CR17	Diode 5082-3188	28480	HP5082-3188	530165-000
CR18	Diode 5082-3188	28480	HP5082-3188	530165-000
CR19	Diode 5082-3188	28480	HP5082-3188	530165-000
CR20	Diode 5082-3188	28480	HP5082-3188	530165-000
CR21	Diode 5082-3188	28480	HP5082-3188	530165-000
CR22	Diode 5082-3188	28480	HP5082-3188	530165-000
CR23	Diode 5082-3188	28480	HP5082-3188	530165-000
CR24	Diode 5082-3188	28480	HP5082-3188	530165-000
CR25	Diode 5082-3188	28480	HP5082-3188	530165-000
CR26	Diode 5082-3188	28480	HP5082-3188	530165-000
CR27	Diode 5082-3188	28480	HP5082-3188	530165-000
CR28	Diode 5082-3188	28480	HP5082-3188	530165-000
CR29	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR30	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR31	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR32	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR33	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR34	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR35	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR36	Diode (Matched S/F 530162 qty 8)	21455	PMS702-05	530179-000
CR37	Diode 5082-3188	28480	HP5082-3188	530165-000
CR38	Diode 5082-3188	28480	HP5082-3188	530165-000
CR39	Diode 1N914	01295	1N914	530058-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
CR40	Diode 1N5713	28480	1N5713	530161-000
J1	Connector Coaxial SMB	19505	209	477317-000
J2	Connector 9 Pin	27264	22-04-2091	477339-000
J3	Connector Coaxial SMB	19505	209	477317-000
J4	Connector Coaxial SMB	19505	209	477317-000
J5	Connector Coaxial SMB	19505	209	477317-000
J6	Connector 5 Pin	27264	22-04-2051	477328-000
J7	Connector Coaxial SMB	19505	209	477317-000
K1	Relay Reed Dip	15636	RA3080-1051	471033-000
L1	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L2	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L3	Inductor 5.6 µH 10%	24226	10/561	400408-000
L4	Inductor 0.47 µH 10%	24226	10/470	400368-000
L5	Inductor 2.2 µH 10%	24226	10/221	400389-000
L6	Inductor 5.6 µH 10%	24226	10/561	400408-000
L7	Inductor 2.2 µH 10%	24226	10/221	400389-000
L8	Inductor 5.6 µH 10%	24226	10/561	400408-000
L9	Inductor 5.6 µH 10%	24226	10/561	400408-000
L10	Inductor 5.6 µH 10%	24226	10/561	400408-000
L11	Inductor 5.6 µH 10%	24226	10/561	400408-000
L12	Inductor 56 µH 10%	24226	10/562	400359-000
L13	Inductor 10 µH 10%	24226	10/102	400361-000
L14	Inductor 0.068 µH 10%	71279	551-5172-07-02-00	400407-000
L15	Inductor 0.068 µH 10%	71279	551-5172-07-02-00	400407-000
L16	Inductor 0.068 µH 10%	71279	551-5172-07-02-00	400407-000
L17	Inductor 10 µH 10%	24226	10/102	400361-000
L18	Inductor 0.082 µH 10%	71279	551-5172-08-02-00	400400-000
L19	Inductor 0.082 µH 10%	71279	551-5172-08-02-00	400400-000
L20	Inductor 0.082 µH 10%	71279	551-5172-08-02-00	400400-000
L21	Inductor 0.10 µH 10%	59474	4416-1K	400299-000
L22	Inductor 0.12 µH 10%	24226	10/120	400364-000
L23	Inductor 0.10 µH 10%	59474	4416-1K	400299-000
L24	Inductor 0.15 µH 10%	24226	10/220	400362-000
L25	Inductor 0.15 µH 10%	24226	10/220	400362-000
L26	Inductor 0.15 µH 10%	24226	10/220	400362-000
L27	Inductor 0.22 µH 10%	24226	10/220	400363-000
L28	Inductor 0.22 µH 10%	24226	10/220	400363-000
L29	Inductor 0.22 µH 10%	24226	10/220	400363-000
L30	Inductor 0.27 µH 10%	59474	4416-6K	400250-000
L31	Inductor 0.27 µH 10%	59474	4416-6K	400250-000
L32	Inductor 0.27 µH 10%	59474	4416-6K	400250-000
L33	Inductor 0.39 µH 10%	24226	10/390	400367-000
L34	Inductor 0.39 µH 10%	24226	10/390	400367-000
L35	Inductor 0.39 µH 10%	24226	10/390	400367-000
L36	Inductor 0.56 µH 10%	24226	10/560	400382-000
L37	Inductor 0.56 µH 10%	24226	10/560	400382-000
L38	Inductor 0.56 µH 10%	24226	10/560	400382-000
L39	Inductor 0.82 µH 10%	24226	10/820	400375-000
L40	Inductor 0.82 µH 10%	24226	10/820	400375-000
L41	Inductor 0.82 µH 10%	24226	10/820	400375-000
L42	Inductor 1.2 µH 10%	24226	10/121	400390-000
L43	Inductor 1.2 µH 10%	24226	10/121	400390-000
L44	Inductor 1.2 µH 10%	24226	10/121	400390-000
L45	Inductor 1.5 µH 10%	24226	10/151	400383-000
L46	Inductor 1.5 µH 10%	24226	10/151	400383-000
L47	Inductor 1.5 µH 10%	24226	10/151	400383-000
L48	Inductor 2.2 µH 10%	24226	10/221	400389-000
L49	Inductor 2.2 µH 10%	24226	10/221	400389-000
L50	Inductor 2.2 µH 10%	24226	10/221	400389-000
L51	Inductor 10 µH 10%	24226	10/102	400361-000
L52	Inductor 3.3 µF 10%	24226	10/331	400370-000
L53	Inductor 3.3 µF 10%	24226	10/331	400370-000
L54	Inductor 3.3 µF 10%	24226	10/331	400370-000
L55	Inductor 0.82 µH 10%	24226	10/820	400375-000
L56	Inductor 0.82 µH 10%	24226	10/820	400375-000
L57	Inductor 0.82 µH 10%	24226	10/820	400375-000
L58	Inductor 1.0 µH 10%	24226	10/101	400369-000
L59	Inductor 1.0 µH 10%	24226	10/101	400369-000
L60	Inductor 4.7 µH 10%	24226	10/471	400384-000
L61	Inductor 1.0 µH 10%	24226	10/101	400369-000
L62	Inductor 4.7 µH 10%	24226	10/471	400384-000
L63	Inductor 4.7 µH 10%	24226	10/471	400384-000
L64	Inductor 0.47 µH 10%	24226	10/470	400368-000
L65	Inductor 5.6 µH 10%	24226	10/561	400408-000
L66	Inductor 0.33 µH 10%	24226	10/330	400366-000
L67	Inductor 56 µH 10%	24226	10/562	400359-000
L68	Inductor 0.47 µH 10%	24226	10/470	400368-000
L69	Inductor 56 µH 10%	24226	10/562	400359-000
L70	Inductor 3.3 µF 10%	24226	10/331	400370-000
L71	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L72	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L73	Inductor 56 µH 10%	24226	10/562	400359-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
L74	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L75	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L76	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L77	Inductor 0.47 µH 10%	24226	10/470	400368-000
L78	Inductor 0.33 µH 10%	24226	10/330	400366-000
L79	Inductor 0.47 µH 10%	24226	10/470	400368-000
Q2	Transistor NPN 2N3904	04713	2N3904	528071-000
Q3	Transistor NPN 2N5109	02735	2N5109	528073-000
Q4	Transistor NPN 2N5179	04713	2N5179	528080-000
Q5	Transistor NPN 2N5179	04713	2N5179	528080-000
Q6	Transistor NPN 2N5109	02735	2N5109	528073-000
R1	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R2	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R3	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R4	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R5	Resistor MF 26.7 ohm 1%	---	RN55D-26R7-F	341141-000
R6	Resistor Network 470 ohm 2% 1.1W	71450	750-81-R470	345018-000
R7	Resistor MF 61.9 ohm 1%	---	RN55D-61R9-F	341176-000
R8	Resistor MF 165 ohm 1%	---	RN55D-1650-F	341221-000
R9	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R10	Resistor MF 182 ohm 1%	---	RN55D-1820-F	341225-000
R11	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R12	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R13	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R14	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R15	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R16	Resistor Network 470 ohm 2% 1.1W	71450	750-81-R470	345018-000
R17	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R18	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R19	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R20	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R21	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R22	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R23	Resistor MF 182 ohm 1%	---	RN55D-1820-F	341225-000
R24	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R25	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R26	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R27	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R28	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R29	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R30	Resistor Network 22k ohm	71450	750-61-R22K	345037-000
R31	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R32	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R33	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R34	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R35	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R36	Resistor Network 22k ohm	71450	750-61-R22K	345037-000
R37	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R38	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R39	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R40	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R41	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R42	Resistor Network 22k ohm	71450	750-61-R22K	345037-000
R43	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R44	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R45	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R46	Resistor MF 82.5 ohm 1%	---	RN55D-82R5-F	341188-000
R47	Resistor MF 1.21k ohm 1%	---	RN55D-1211-F	341308-000
R48	Resistor MF 90.9 ohm 1%	---	RN55D-90R9-F	341192-000
R49	Resistor MF 82.5 ohm 1%	---	RN55D-82R5-F	341188-000
R50	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R51	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R53	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R54	Resistor MF 3.92k ohm 1%	---	RN55D-3921-F	341357-000
R57	Resistor Comp 51 ohm 5% 0.25W	01121	CB	300051-000
R58	Resistor MF 5.62k ohm 1%	---	RN55D-5621-F	341372-000
R59	Resistor MF 3.32k ohm 1%	---	RN55D-3321-F	341350-000
R60	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R61	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R62	Resistor MF 47.5 ohm 1%	---	RN55D-47R5-F	341165-000
R63	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R64	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R65	Resistor Comp 180 ohm 5%	01121	EB	344225-000
R66	Resistor Comp 150 ohm 5%	01121	EB	344217-000
R67	Resistor Comp 10 ohm 5%	01121	CB	343100-000
R68	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R69	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R70	Resistor MF 267 ohm 1%	---	RN55D-2670-F	341241-000
R71	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R72	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R73	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R74	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R75	Resistor MF 1.50k ohm 1%	---	RN55D-1501-F	341317-000
R76	Resistor MF 82.5k ohm 1%	---	RN55D-8252-F	341488-000
R77	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R78	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R79	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R80	Resistor Var 50k ohm 10% 0.5W	73138	72PR50K	311393-000
R81	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R82	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R83	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R84	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R85	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R86	Resistor MF 221 ohm 1%	---	RN55D-2210-F	341233-000
R87	Resistor MF 150 ohm 1%	---	RN55D-1500-F	341217-000
R88	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R89	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R90	Resistor MF 26.7 ohm 1%	---	RN55D-26R7-F	341141-000
R91	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R92	Resistor MF 26.7 ohm 1%	---	RN55D-26R7-F	341141-000
R93	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
R94	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R95	Resistor MF 150 ohm 1%	---	RN55D-1500-F	341217-000
R96	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R97	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R98	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R99	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R100	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R101	Resistor Chip 100 ohm 5% 0.5W	50316	WA-7PS-101JS	339999-000
R102	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R103	Resistor Comp 180 ohm 5%	01121	EB	344225-000
R104	Resistor Comp 150 ohm 5%	01121	EB	344217-000
R105	Resistor Chip 15 ohm 5% 0.5W	50316	WA-7PG-150JS	339998-000
R106	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R107	Resistor Comp 6.2 ohm 5%	01121	CB	300303-000
R108	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R109	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
T1	Transformer RF	15542	T3-1T	410083-000
T2	Transformer RF	15542	T3-1T	410083-000
T3	Transformer RF	15542	T2.5-6T	410088-000
T4	Transformer RF	15542	T2.5-6T	410088-000
U1	IC MWA-230 Op Amp	04713	MWA-230	535072-000
U2	IC MC10124P	04713	MC10124P	534241-000
U3	IC MC10211P	04713	MC10211P	534244-000
U4	IC MC1670L	04713	MC1670L	534248-000
U5	IC MC10231P	04713	MC10231P	534137-000
U6	IC MC10109P	04713	MC10109P	534240-000
U7	IC 74LS138N 1 of 8 Decoder	01295	SN74LS138N	534246-000
U8	IC MC10102P	04713	MC10102P	534134-000
U9	IC MC10131P	04713	MC10131P	534136-000
U10	IC MC10124P	04713	MC10124P	534241-000
U11	IC MC10102P	04713	MC10102P	534134-000
U12	IC MC10131P	04713	MC10131P	534136-000
U13	IC 7407N HEX Buffer Open Collector	01295	SN7407N	534066-000
U14	IC 74LS138N 1 of 8 Decoder	01295	SN74LS138N	534246-000
U15	IC 7407N HEX Buffer Open Collector	01295	SN7407N	534066-000
U16	IC 74LS138N 1 of 8 Decoder	01295	SN74LS138N	534246-000
U17	IC 7407N HEX Buffer Open Collector	01295	SN7407N	534066-000
U18	IC GPD463 Op Amp	27014	GPD463	535030-000
U19	IC SN7406N Hex Buffer	01295	SN7406N	534067-000
U20	IC NE5534AN Op Amp	18324	NE5534AN	535061-000
U21	IC NE5534AN Op Amp	18324	NE5534AN	535061-000
U22	IC AD539JD	51640	AD539JD	535100-000
U23	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U24	IC LM310N Op Amp	27014	LM310N	535035-000
XK1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XQ2	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ3	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ4	Socket Transistor 4 Pin	17117	7004-265-5	473051-000
XQ5	Socket Transistor 4 Pin	17117	7004-265-5	473051-000
XQ6	Socket Transistor 3 Pin	07047	90363-202	473046-000
XT1	Socket IC 6 Pin	06776	ICN-063-S3-G	473054-000
XT2	Socket IC 6 Pin	06776	ICN-063-S3-G	473054-000
XT3	Socket IC 6 Pin	06776	ICN-063-S3-G	473054-000
XT4	Socket IC 6 Pin	06776	ICN-063-S3-G	473054-000
XU2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU6	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU7	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU8	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU9	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000

Replaceable Parts List for PWA RF Circuit PL 103210-00E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
XU10	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU11	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU12	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU13	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU14	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU15	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU16	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU17	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU19	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU20	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU21	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU22	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU23	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU24	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XZ1-1	Connector Female	86026	450-7004-1-03	479347-000
XZ1-2	Connector Female	86026	450-7004-1-03	479347-000
XZ1-3	Connector Female	86026	450-7004-1-03	479347-000
XZ1-4	Connector Female	86026	450-7004-1-03	479347-000
XZ1-5	Connector Female	86026	450-7004-1-03	479347-000
XZ1-6	Connector Female	86026	450-7004-1-03	479347-000
XZ1-7	Connector Female	86026	450-7004-1-03	479347-000
XZ1-8	Connector Female	86026	450-7004-1-03	479347-000
Z1	Mixer SRA-1	15542	SRA-1	423000-000

Replaceable Parts List for Counter Cavity Cover Assembly PL 102414-01C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
L1	Inductor 10 µH 10%	24226	10/102	400361-000
L2	Inductor 10 µH 10%	24226	10/102	400361-000
L3	Inductor 10 µH 10%	24226	10/102	400361-000
L4	Inductor 10 µH 10%	24226	10/102	400361-000
L5	Inductor 10 µH 10%	24226	10/102	400361-000
L6	Inductor 10 µH 10%	24226	10/102	400361-000
L7	Inductor 10 µH 10%	24226	10/102	400361-000
L8	Inductor 10 µH 10%	24226	10/102	400361-000
L9	Inductor 10 µH 10%	24226	10/102	400361-000
L10	Inductor 10 µH 10%	24226	10/102	400361-000
L11	Inductor 10 µH 10%	24226	10/102	400361-000
L12	Inductor 10 µH 10%	24226	10/102	400361-000
L13	Inductor 10 µH 10%	24226	10/102	400361-000
L14	Inductor 10 µH 10%	24226	10/102	400361-000
L15	Inductor 10 µH 10%	24226	10/102	400361-000
L16	Inductor 10 µH 10%	24226	10/102	400361-000

Replaceable Parts List for PWA CTR Filter Outside PL 102416-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C2	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C3	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C4	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C5	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C6	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C7	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C8	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C9	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C10	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C11	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C12	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C13	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C14	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C15	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C16	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
R1	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
R2	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000

Replaceable Parts List for PWA CTR Filter Inside PL 102417-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C17	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C18	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C19	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C20	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C21	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C22	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C23	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C24	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C25	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000

Replaceable Parts List for PWA CTR Filter Inside PL 102417-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C26	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C27	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C28	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C29	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C30	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C31	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C32	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
J1	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
R3	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R4	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000

Replaceable Parts List for PWA Phase Lock Counter PL 102418-01E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer Chip 39 pF 10% 50V	61637	C1210C390K5GAH	224365-000
C2	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C3	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C4	Capacitor Cer Chip 39 pF 10% 50V	61637	C1210C390K5GAH	224365-000
C5	Capacitor Cer Chip 4700 pF 10% 50V	61637	C1210C472K5XAH	224341-000
C6	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C7	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C8	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C9	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C10	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C11	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C12	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C13	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C14	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C15	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C16	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C17	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C18	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C19	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C20	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C21	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C22	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C23	Capacitor Tant 1 µF 10% 35V only	56289	196D105X9035HA1 only	283216-000
C24	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C25	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C26	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C27	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C28	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C29	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C30	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C31	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C32	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C33	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C34	Capacitor MPC 0.01 µF 10% 400V	14752	652A-1-E103K	234155-000
C35	Capacitor MPC 1.0 µF 10% 100V	14752	652A-1-B105K	234160-000
C36	Capacitor MPC 0.015 µF 10% 400V	14752	652A-1-E153K	234156-000
C37	Capacitor MPC 1.0 µF 5% 200V	56289	260P105S5S4	234154-000
C38	Capacitor MPC 0.068 µF 10% 200V	14752	652A-1-C683K	234158-000
C39	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C40	Capacitor Cer 0.01 µF 100V	32897	805-000X5V0103Z	224119-000
C41	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C42	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C43	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C44	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C45	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C46	Capacitor MPC 0.22 µF 10% 100V	14752	652A-1-B224K	234159-000
C47	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C48	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C49	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C50	Capacitor EL 10 µF 20% 25V	S4217	SM-25-V8-10-M	283336-000
C51	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C52	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C53	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
CR1	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
CR2	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
CR3	Diode Zener 1N5232B 5.6V	04713	1N5232B	530119-000
CR4	Diode Zener 1N5242B 12V	04713	1N5242B	530146-000
CR5	Diode Zener 1N5242B 12V	04713	1N5242B	530146-000
CR6	Diode 1N914	01295	1N914	530058-000
CR7	Diode 1N914	01295	1N914	530058-000
DS1	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000
DS2	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000
DS3	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000
DS4	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000
DS5	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000
DS6	LED HLMP-6620 Red Diffused	28480	HLMP-6620	536026-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA Phase Lock Counter PL 102418-01E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
J1	Connector Coaxial SMB	19505	209	477317-000
J2	Connector Coaxial SMB	19505	209	477317-000
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J5	Connector Coaxial SMB	19505	209	477317-000
J6	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
L1	Inductor 1.0 µH 10%	24226	10/101	400369-000
L2	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L3	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L4	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
L5	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
L6	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L7	Inductor 1.0 µH 10%	24226	10/101	400369-000
Q1	Transistor NPN MPS6507	04713	MPS6507	528070-000
Q2	Transistor PNP 2N3906	04713	2N3906	528076-000
Q3	Transistor PNP 2N3906	04713	2N3906	528076-000
Q4	Transistor NPN 2N3904	04713	2N3904	528071-000
Q5	Transistor PNP 2N3906	04713	2N3906	528076-000
Q6	Transistor NPN 2N5191	04713	2N5191	528136-000
Q7	Transistor PNP 2N5194	04173	PNP 2N5194	528137-000
Q8	Transistor PNP MM4001	04713	PNP MM4001	528141-000
Q9	Transistor NPN MM3001	04713	NPN MM3001	528140-000
R1	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R2	Resistor MF 1.30k ohm 1%	---	RN55D-1301-F	341311-000
R3	Resistor MF 47.5 ohm 1%	---	RN55D-47R5-F	341165-000
R4	Resistor Comp 750 ohm 5%	01121	EB	344284-000
R5	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R6	Resistor Comp 51 ohm 5% 0.25W	01121	CB	300051-000
R7	Resistor Network 81 ohm/130 ohm	73138	783-5-R81/130	345028-000
R8	Resistor Network 81 ohm/130 ohm	73138	783-5-R81/130	345028-000
R9	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R10	Resistor MF 130 ohm 1%	---	RN55D-1300-F	341211-000
R11	Resistor MF 82.5 ohm 1%	---	RN55D-82R5-F	341188-000
R12	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R13	Resistor Network 81 ohm/130 ohm	73138	783-5-R81/130	345028-000
R14	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R15	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R16	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R17	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R18	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R19	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R20	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R21	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R22	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R23	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R24	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R25	Resistor Network 470 ohm	71450	750-61-R470	345029-000
R26	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R27	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R28	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R29	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R30	Resistor MF 3.57k ohm 1%	---	RN55D-3571-F	341353-000
R31	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R32	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R33	Resistor MF 9.09k ohm 1%	---	RN55D-9091-F	341492-000
R34	Resistor MF 9.09k ohm 1%	---	RN55D-9091-F	341392-000
R35	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R36	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R37	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R38	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R39	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R40	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R41	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R42	Resistor MF 68.1k ohm 1%	---	RN55D-6812-F	341480-000
R43	Resistor MF 1.00M ohm 1%	---	RN55D-1004-F	341600-000
R44	Resistor MF 18.2k ohm 1%	---	RN55D-1822-F	341425-000
R45	Resistor MF 825k ohm 1%	---	RN55D-8253-F	341588-000
R46	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R47	Resistor MF 182k ohm 1%	---	RN55D-1823-F	341528-000
R48	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R49	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R50	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R51	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R52	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R53	Resistor Comp 12k ohm 5%	01121	EB	344408-000
R54	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R55	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R56	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R57	Resistor MF 681 ohm 1%	---	RN55D-6810-F	341280-000
R58	Resistor MF 511 ohm 1%	---	RN55D-5110-F	341268-000
R59	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000

Replaceable Parts List for PWA Phase Lock Counter PL 102418-01E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R60	Resistor MF 1.50k ohm 1%	----	RN55D-1501-F	341317-000
R61	Resistor MF 2.00k ohm 1%	----	RN55D-2001-F	341329-000
R62	Resistor MF 2.00k ohm 1%	----	RN55D-2001-F	341329-000
R63	Resistor MF 10.0k ohm 1%	----	RN55D-1002-F	341400-000
R64	Resistor MF 6.81k ohm 1%	----	RN55D-6811-F	341380-000
R65	Resistor MF 6.81k ohm 1%	----	RN55D-6811-F	341380-000
U1	IC MC10124P	04713	MC10124P	534241-000
U2	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U3	IC 11C90DC	07263	11C90DC	534250-000
U4	IC MC10102P	04713	MC10102P	534134-000
U5	IC MC10231P	04713	MC10231P	534137-000
U6	IC MC10210P	04713	MC10210P	534243-000
U7	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U8	IC MC10124P	04713	MC10124P	534241-000
U9	IC MC10136P	04713	MC10136P	534179-000
U10	IC MC10102P	04713	MC10102P	534134-000
U11	IC MC10124P	04713	MC10124P	534241-000
U12	IC MC10136P	04713	MC10136P	534179-000
U13	IC MC10231P	04713	MC10231P	534137-000
U14	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U15	IC MC10124P	04713	MC10124P	534241-000
U16	IC MC10136P	04713	MC10136P	534179-000
U17	IC MC10102P	04713	MC10102P	534134-000
U18	IC MC10105P	04713	MC10105P	534239-000
U19	IC MC10124P	04713	MC10124P	534241-000
U20	IC MC10136P	04713	MC10136P	534179-000
U21	IC MC10125P	04713	MC10125P	534242-000
U22	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U23	IC MC10124P	04713	MC10124P	534241-000
U24	IC MC10136P	04713	MC10136P	534179-000
U25	IC MC10109P	04713	MC10109P	534240-000
U26	IC MC10124P	04713	MC10124P	534241-000
U27	IC MC10136P	04713	MC10136P	534179-000
U28	IC SN74123N	01295	SN74123N	534071-000
U30	IC SN74LS221N	01295	SN74LS221N	534235-000
U31	IC SN74LS490N	01295	SN74LS490N	534238-000
U32	IC Am6080DC Op Amp	34335	Am6080DC	535071-000
U33	IC SN74LS74N	01295	SN74LS74N	534157-000
U34	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U35	IC CA3080AS Op Amp	02735	CA3080AS	535039-000
U36	IC SW-02FQ Analog Switch	06665	SW-02 FQ	534259-000
U37	IC SW-02FQ Analog Switch	06665	SW-02 FQ	534259-000
U38	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U39	IC AD581JH Volt Ref	51640	AD581JH	535053-000
U40	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U41	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U42	IC 74LS02N Quad 2 Input NOR	01295	SN74LS02N	534154-000
U43	IC SN74LS290N	01295	SN74LS290N	534328-000
U44	IC SN74LS390N	01295	SN74LS390N	534329-000
XQ2	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ3	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ4	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ5	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ8	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ9	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU1	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU2	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU6	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU7	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU8	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU9	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU10	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU11	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU12	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU13	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU14	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU15	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU16	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU17	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU18	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU19	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU20	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU21	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU22	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU23	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU24	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU25	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU26	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA Phase Lock Counter PL 102418-01E

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
XU27	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU28	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU30	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU31	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU32	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU33	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU34	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU35	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU36	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU37	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU38	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU40	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU41	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU42	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU43	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU44	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000

Replaceable Parts List for PWA FM PL 103207-00C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C2	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C3	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C4	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C5	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C6	Capacitor Mica 15 pF 5% 300V	20307	DM5-CC150J	205035-000
C7	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C8	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C9	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C10	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C11	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C12	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C13	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C14	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C15	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C16	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C17	Capacitor Mica 2200 pF 5% 500V	20307	DM19-222J	200525-000
C18	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C19	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C20	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C21	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C22	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C23	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C24	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C25	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C26	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C27	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C28	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C29	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C30	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C31	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C32	Capacitor Var 1.9-15.7 pF	74970	187-0109-005	275156-000
C33	Capacitor Mica 15 pF 5% 300V	20307	DM5-CC150J	205035-000
C34	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C35	Capacitor MPC 0.1 µF 10% 200V	14752	652A-1-C104K	234161-000
C36	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C37	Capacitor EL 5 µF 150V	56289	TE-1504	283173-000
C38	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C39	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
CR1	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
CR2	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
CR3	Diode 1N914	01295	1N914	530058-000
CR4	Diode 1N914	01295	1N914	530058-000
CR5	Diode 1N914	01295	1N914	530058-000
CR6	Diode 1N914	01295	1N914	530058-000
J1	Connector Coaxial SMB	19505	209	477317-000
J2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
K1	Relay Reed Form C	78277	191TE1C1-5S	471034-000
K2	Relay Reed Dip	15636	RA3080-1051	471033-000
K3	Relay Reed Form C	78277	191TE1C1-5S	471034-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
L2	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L3	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L4	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
L5	Inductor 5.6 µH 10%	59474	4435-1K	400308-000
Q1	Transistor PNP 2N3906	04713	2N3906	528076-000
Q2	Transistor PNP MM4001	04713	PNP MM4001	528141-000
Q3	Transistor NPN MM3001	04713	NPN MM3001	528140-000
R1	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R2	Resistor MF 1.00M ohm 1%	---	RN55D-1004-F	341600-000
R3	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000

Replaceable Parts List for PWA FM PL 103207-00C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R4	Resistor MF 600.0 ohm 0.25% 1/8W	03888	PME55-T2 CHAR.C	324215-000
R5	Resistor MF 4.02k ohm 1%	---	RN55D-4021-F	341358-000
R6	Resistor MF 22.1 ohm 1%	---	RN55D-22R1-F	341133-000
R7	Resistor MF 4.02k ohm 1%	---	RN55D-4021-F	341358-000
R8	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R9	Resistor MF 4.02k ohm 1%	---	RN55D-4021-F	341358-000
R10	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R11	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
R12	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R13	Resistor MF 8.06k ohm 1%	---	RN55D-8061-F	341387-000
R14	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R15	Resistor MF 22.1 ohm 1%	---	RN55D-22R1-F	341133-000
R16	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000
R18	Resistor MF 1.47k ohm 1%	---	RN55D-1471-F	341316-000
R19	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R20	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R21	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R22	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R23	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R24	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R25	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R26	Resistor MF 1.47k ohm 1%	---	RN55D-1471-F	341316-000
R27	Resistor MF 1.00M ohm 1%	---	RN55D-1004-F	341600-000
R28	Resistor MF 2.21k ohm 1%	---	RN55D-2211-F	341333-000
R29	Resistor Var 500 ohm 10% 0.5W	73138	82PAR500	311381-000
R30	Resistor MF 4.000k ohm 0.1% 1/8W	03888	PME55	324313-000
R31	Resistor MF 2.000k ohm 0.1% 1/8W	03888	PME55	324275-000
R32	Resistor MF 1.200k ohm 0.1% 1/8W	03888	PME55	324244-000
R33	Resistor MF 400.0 ohm 0.1% 1/8W	03888	PME55-T2	324190-000
R34	Resistor MF 200.0 ohm 0.1% 1/8W	03888	PME55	324162-000
R35	Resistor MF 200.0 ohm 0.1% 1/8W	03888	PME55	324162-000
R36	Resistor MF 4.000k ohm 0.1% 1/8W	03888	PME55	324313-000
R37	Resistor MF 2.000k ohm 0.1% 1/8W	03888	PME55	324275-000
R38	Resistor MF 1.000k ohm 0.1% 1/8W	03888	PME55-T0 CHAR.C	324241-000
R39	Resistor MF 1.000k ohm 0.1% 1/8W	03888	PME55-T0 CHAR.C	324241-000
R40	Resistor MF 24.3k ohm 1%	---	RN55D-2432-F	341437-000
R41	Resistor MF 24.3k ohm 1%	---	RN55D-2432-F	341437-000
R42	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R43	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R44	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R45	Resistor MF 60.4k ohm 1%	---	RN55D-6042-F	341475-000
R46	Resistor MF 165k ohm 1%	---	RN55D-1653-F	341521-000
R47	Resistor MF 43.2k ohm 1%	---	RN55D-4322-F	341461-000
R48	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R49	Resistor Comp 3.9M ohm 5%	01121	CB	343657-000
R50	Resistor MF 39.2k ohm 1%	---	RN55D-3922-F	341457-000
R51	Resistor MF 9.09k ohm 1%	---	RN55D-9091-F	341392-000
R52	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R53	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R54	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R55	Resistor MF 4.75k ohm 1%	---	RN55D-4751-F	341365-000
R56	Resistor MF 7.50k ohm 1%	---	RN55D-7501-F	341384-000
R57	Resistor MF 7.50k ohm 1%	---	RN55D-7501-F	341384-000
R58	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R59	Resistor MF 619 ohm 1%	---	RN55D-6190-F	341276-000
R60	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R61	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R62	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R63	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R64	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R65	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R66	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R67	Resistor MF 200 ohm 1%	---	RN55D-2000-F	341229-000
R68	Resistor MF 4.75k ohm 1%	---	RN55D-4751-F	341365-000
R69	Resistor MF 56.2 ohm 1%	---	RN55D-56R2-F	341172-000
R70	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R71	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R72	Resistor MF 5.62k ohm 1%	---	RN55D-5621-F	341372-000
R73	Resistor MF 4.32k ohm 1%	---	RN55D-4321-F	341361-000
R74	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
R75	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R76	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R77	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R78	Resistor MF 47.5k ohm 1%	---	RN55D-4752-F	341465-000
R79	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R80	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R81	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R82	Resistor MF 100 ohm 1%	---	RN55D-1000-F	341200-000
R84	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R85	Resistor MF 4.32k ohm 1%	---	RN55D-4321-F	341361-000
U1	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000

Replaceable Parts List for PWA FM PL 103207-00C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
U2	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U3	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U4	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U5	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U6	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U7	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U8	IC CD4051BE (only)	02735	CD4051BE (only)	534209-000
U9	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U10	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U11	IC CD4051BE (only)	02735	CD4051BE (only)	534209-000
U12	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U13	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U14	IC LF13508D	27014	LF13508D	534253-000
U15	IC RC4200ANB1	07933	RC4200ANB	535083-000
U16	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U17	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U18	IC LF13508D	27014	LF13508D	534253-000
U19	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U20	IC SN74LS42N	01295	SN74LS42N	534210-000
U21	IC LM324N Op Amp	27014	LM324N	535068-000
U22	IC LM324N Op Amp	27014	LM324N	535068-000
XK1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XK2	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XK3	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XQ1	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU1	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU2	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU3	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU4	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU5	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU6	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU7	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU8	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU9	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU10	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU11	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU12	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU13	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU14	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU15	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU16	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU17	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU18	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU19	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU20	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU21	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU22	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000

Replaceable Parts List for PWA AM Channel PL 103206-00B

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C2	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C3	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C4	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C5	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C6	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C7	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C8	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C9	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C10	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C11	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C12	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C13	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C14	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C15	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C16	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C17	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C18	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C19	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C20	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
CR1	Diode 1N914	01295	1N914	530058-000
CR2	Diode 1N914	01295	1N914	530058-000
CR3	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
CR4	Diode FDH-300	07263	FDH300 (WIV 125)	530052-000
J1	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J4	Connector Coaxial SMB	19505	209	477317-000
K1	Relay Reed Form C	78277	191TE1C1-5S	471034-000
K2	Relay Reed Form C	78277	191TE1C1-5S	471034-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA AM Channel PL 103206-00B

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
L1	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
L2	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
L3	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
L4	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
Q1	Transistor PNP 2N3906	04713	2N3906	528076-000
R1	Resistor MF 600.0 ohm 0.25% 1/8W	03888	PME55-T2 CHAR.C	324215-000
R2	Resistor MF 1.00M ohm 1%	---	RN55D-1004-F	341600-000
R3	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R4	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
R5	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R6	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R7	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R8	Resistor MF 2.67k ohm 1%	---	RN55D-2671-F	341341-000
R9	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R10	Resistor MF 22.1 ohm 1%	---	RN55D-22R1-F	341133-000
R11	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R12	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R13	Resistor MF 22.1 ohm 1%	---	RN55D-22R1-F	341133-000
R14	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R15	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R16	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R17	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R18	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R19	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R20	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R21	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R22	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R23	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R24	Resistor Var 5k ohm 10% 0.5W	73138	82PAR5K	311372-000
R25	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R26	Resistor MF 4.75k ohm 1%	---	RN55D-4751-F	341365-000
R27	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R28	Resistor MF 2.67k ohm 1%	---	RN55D-2671-F	341341-000
R29	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
U1	IC UDN2983A	56289	UDN2983A	534255-000
U2	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U3	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U4	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U5	IC TL071CP Op Amp	01295	TL071CP	535085-000
U6	IC TL074CN Quad Op Amp	01295	TL074CN	535082-000
U7	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U8	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U9	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U10	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U11	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U12	IC DAC-08EP D/A Converter	06665	DAC-08EP	421037-000
XK1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XK2	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XQ1	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU1	Socket IC 18 Pin	06776	ICN-183-S3-G	473045-000
XU2	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU3	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU4	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU5	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU6	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU7	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU8	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU9	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU10	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU11	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU12	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000

Replaceable Parts List for PWA Mod. Oscillator PL 102439-01H

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C3	Capacitor PE 2 µF 10% 50V	56289	431P205X9R5	234154-000
C4	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C5	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C6	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C7	Capacitor Mica 1000 pF 1% 100V	20307	DM15-102F	200113-000
C8	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C9	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C10	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C11	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C12	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C13	Capacitor Cer 0.10 µF 20% 50V	04222	SR215E104MAA	224268-000
C14	Capacitor Mica 43 pF 5% 300V	20307	DM5-EC430J	205014-000
C15	Capacitor Mica 1000 pF 1% 100V	20307	DM15-102F	200113-000
C16	Capacitor Var 1.9-15.7 pF	74970	187-0109-005	275156-000
C17	Capacitor Cer 1.0 µF 20% 50V	04222	SR305E105MAA	224264-000
C18	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C19	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA Mod. Oscillator PL 102439-01H

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C20	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C21	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C22	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C23	Capacitor Mica 43 pF 5% 300V	20307	DM5-EC430J	205014-000
C24	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000
C25	Capacitor Tant 100 µF 20% 20V	56289	196D107X0020TE4	283313-000
C26	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C27	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C28	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C29	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C30	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C31	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C32	Capacitor Mica 33 pF 5% 300V	20307	DM5-EC330J	205010-000
C33	Capacitor MPC 0.22 µF 10% 100V	14752	652A-1-B224K	234159-000
CR1	Diode 1N5713	28480	1N5713	530161-000
CR2	Diode 1N914	01295	1N914	530058-000
CR3	Diode 1N914	01295	1N914	530058-000
CR4	Diode 1N5713	28480	1N5713	530161-000
CR5	Diode 1N914	01295	1N914	530058-000
CR6	Diode 1N914	01295	1N914	530058-000
CR7	Diode Zener 1N5242B 12V	04713	1N5242B	530146-000
DS1	Opto-Coupler VTL5C3	18178	VTL5C3	325015-000
K1	Relay Reed Form C	78277	191TE1C1-5S	471034-000
K2	Relay Reed Form C	78277	191TE1C1-5S	471034-000
L1	Inductor 4.7 µH 10%	24226	10/471	400384-000
L2	Inductor 4.7 µH 10%	24226	10/471	400384-000
L3	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
L4	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
L5	Inductor RF VK200-20/4B AKD	02114	VK200-20/4B	400409-000
Q1	Transistor PNP 2N3906	04713	2N3906	528076-000
R1	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R2	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R3	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R4	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R5	Resistor MF 18.2k ohm 1%	---	RN55D-1822-F	341425-000
R6	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R7	Resistor MF 392 ohm 1%	---	RN55D-3920-F	341257-000
R8	Resistor MF 15.0k ohm 1%	---	RN55D-1502-F	341417-000
R9	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R10	Resistor MF 2.43k ohm 1%	---	RN55D-2431-F	341337-000
R11	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R12	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R13	Resistor Var 10k ohm 10% 0.5W	73138	82PAR10K	311373-000
R14	Resistor Var 100k ohm 10% 0.5W	73138	82PAR100K	311376-000
R15	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R16	Resistor MF 90.9k ohm 1%	---	RN55D-9092-F	341492-000
R17	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R18	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R19	Resistor MF 5.62k ohm 1%	---	RN55D-5621-F	341372-000
R20	Resistor MF 56.2k ohm 1%	---	RN55D-5622-F	341472-000
R21	Resistor MF 562k ohm 1%	---	RN55D-5623-F	341572-000
R22	Resistor MF 1.21k ohm 1%	---	RN55D-1211-F	341308-000
R23	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R24	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R25	Resistor MF 20.0k ohm 1%	---	RN55D-2002-F	341429-000
R26	Resistor MF 200k ohm 1%	---	RN55D-2003-F	341529-000
R27	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R28	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R29	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R30	Resistor MF 61.9k ohm 1%	---	RN55D-6192-F	341476-000
R31	Resistor MF 619k ohm 1%	---	RN55D-6193-F	341576-000
R32	Resistor MF 1.00M ohm 1%	---	RN55D-1004-F	341600-000
R33	Resistor MF 6.19k ohm 1%	---	RN55D-6191-F	341376-000
R34	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R35	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R36	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R37	Resistor MF 7.50k ohm 1%	---	RN55D-7501-F	341384-000
R38	Resistor MF 20.0 ohm 1%	---	RN55D-20R0-F	341129-000
R39	Resistor MF 20.0 ohm 1%	---	RN55D-20R0-F	341129-000
R40	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R41	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R42	Resistor MF 9.09k ohm 1%	---	RN55D-9091-F	341392-000
R43	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R44	Resistor MF 8.25k ohm 1%	---	RN55D-8251-F	341388-000
R45	Resistor MF 600.0 ohm 0.25% 1/8W	03888	PME55-T2 CHAR.C	324215-000
R46	Resistor MF 6.81k ohm 1%	---	RN55D-6811-F	341380-000
R47	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R48	Resistor MF 604 ohm 1%	---	RN55D-6040-F	341275-000
R49	Resistor MF 2.67k ohm 1%	---	RN55D-2671-F	341341-000
R50	Resistor MF 13.3k ohm 1%	---	RN55D-1332-F	341412-000
R51	Resistor MF 2.43k ohm 1%	---	RN55D-2431-F	341337-000
R52	Resistor Var 1k ohm 10% 0.5W	73138	82PAR1K	311370-000
R53	Resistor MF 2.67k ohm 1%	---	RN55D-2671-F	341341-000

Replaceable Parts List for PWA Mod. Oscillator PL 102439-01H

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R54	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R55	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R56	Resistor Var 50k ohms 10% 0.5W	73138	82PAR50k	311375-000
U1	IC TL084BCN Op Amp	01295	TL084BCN	535088-000
U2	IC AD7533KN D/A Converter	51640	AD7533KN	535086-000
U3	IC TL074CN Quad Op Amp	01295	TL074CN	535082-000
U4	IC TL084BCN Op Amp	01295	TL084BCN	535088-000
U5	IC AD581JH Volt Ref	51640	AD581JH	535053-000
U6	IC CD4052BE	02735	CD4052BE	534140-000
U7	IC AD7533KN D/A Converter	51640	AD7533KN	535086-000
U8	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U9	IC AM6012DC High Speed D/A Converter	34335	Am6012DC	535070-000
U10	IC NE5534AN Op Amp	18324	NE5534AN	535061-000
U11	IC NE5534AN Op Amp	18324	NE5534AN	535061-000
U12	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U13	IC SN74LS75N	01295	SN74LS75N	534264-000
U14	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U15	IC SN74LS373N	01295	IC SN74LS373N	534237-000
XDS1-1	Socket Double M/F 473072	04901	BEC	473074-000
XDS1-1	Socket Single M/F 473072	04901	BEC	473073-000
XDS1-2	Socket Single M/F 473072	04901	BEC	473073-000
XK1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XK2	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XQ1	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU4	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU5	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU6	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU7	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU8	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU9	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU10	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU11	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU12	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU13	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU14	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU15	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000

Replaceable Parts List for PWA I/O PL 102437-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C2	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C3	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C4	Capacitor EL 100 µF 20% 25V	54217	SM-25-VB-100-M	283334-000
C5	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C6	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C7	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C8	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
J1	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J6	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J17	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
R1	Resistor Network 3.3k ohm 2% 1.5W	71450	750-101-R3.3K	345030-000
R2	Resistor Network 3.3k ohm 2% 1.5W	71450	750-101-R3.3K	345030-000
R3	Resistor Network 3.3k ohm 2% 1.5W	71450	750-101-R3.3K	345030-000
R4	Resistor Network 3k/6.2k ohm 2%	73138	785-5-R3K/6.2K	345031-000
R5	Resistor Network 3k/6.2k ohm 2%	73138	785-5-R3K/6.2K	345031-000
S1	Switch Network 5 Position	81073	76B05S	465282-000
S2	Switch Network 8 Position	81073	76SB08S	465283-000
U1	IC Am25LS2538	34335	Am25LS2538	534245-000
U2	IC Am25LS2538	34335	Am25LS2538	534245-000
U3	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U4	IC Am25LS2538	34335	Am25LS2538	534245-000
U5	IC SN74LS367N	01295	SN74LS367N	534257-000
U6	IC 74LS08N Quad 2 Input AND	01295	SN74LS08N	534156-000
U7	IC 74LS32N Quad 2 Input OR	01295	SN74LS32N	534168-000
U8	IC 74LS32N Quad 2 Input OR	01295	SN74LS32N	534168-000
U9	IC SN74LS244N	01295	SN74LS244N	534247-000
U10	IC SN74LS244N	01295	SN74LS244N	534247-000
U11	IC Am8255APC Interface	34335	AM 8255 APC	534171-000
U12	IC Am8255APC Interface	34335	AM 8255 APC	534171-000
U13	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U14	IC 74LS02N Quad 2 Input NOR	01295	SN74LS02N	534154-000
U15	IC SN74LS00N	01295	SN74LS00N	534167-000
U16	IC SN7438N	01295	SN7438N	534108-000
U17	IC N8T26AN	07263	N8T26AN	534097-000

Replaceable Parts List for PWA I/O PL 102437-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
U18	IC N8T26AN	07263	N8T26AN	534097-000
U19	IC SN74LS74N	01295	SN74LS74N	534157-000
XU1	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU2	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU3	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU4	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU6	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU7	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU8	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU9	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU10	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU11	Socket IC 40 Pin	06776	ICN-406-S4-G	473052-000
XU12	Socket IC 40 Pin	06776	ICN-406-S4-G	473052-000
XU13	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU14	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU15	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU16	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU17	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU18	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU19	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000

Replaceable Parts List for PWA CPU PL 103205-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C2	Capacitor Mica 47 pF 5% 300V	20307	DM5-EC470J	205018-000
C3	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
C4	Capacitor Mica 100 pF 5% 300V	20307	DM5-FC101J	205006-000
C5	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C6	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C7	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
C8	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C9	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
C10	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
C11	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C12	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C13	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C14	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C15	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
C16	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
CR1	Diode 1N914	01295	1N914	530058-000
CR2	Diode 1N914	01295	1N914	530058-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
L2	Inductor 100 µH 10%	59474	1326-7K	400291-000
R1	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R2	Resistor MF 475 ohm 1%	---	RN55D-4750-F	341265-000
R3	Resistor Network 3k/6.2k ohm 5%	73138	783-5-R3K/6.2K	345033-000
R4	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R5	Resistor MF 22.1k ohm 1%	---	RN55D-2212-F	341433-000
R6	Resistor MF 332 ohm 1%	---	RN55D-3320-F	341250-000
R7	Resistor Network 100k ohm 2%	71450	750-61-R100K	345032-000
U1	IC CD4023AE	02735	CD4023AE	534143-000
U2	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U3	IC Z80-CPU-PS	56708	Z80-CPU-PS	534159-000
U4	IC SN74LS244N	01295	SN74LS244N	534247-000
U5	IC SN74LS244N	01295	SN74LS244N	534247-000
U6	IC SN74LS244N	01295	SN74LS244N	534247-000
U7	IC DP8304BN	27014	DP8304BN	534251-000
U8	IC 74LS138N 1 of 8 Decoder	01295	SN74LS138N	534246-000
U9	IC 2732 Eprom M/F 534268	04901	BEC	534333-00A
U10	IC 2732 Eprom M/F 534268	04901	BEC	534334-00A
U11	IC 2732 Eprom M/F 534268	04901	BEC	534335-00A
U13	IC 74LS138N 1 of 8 Decoder	01295	SN74LS138N	534246-000
U14	IC MSM5128-20-RS	52464	MSM5128-20-RS	534304-000
U15	IC CD4066AE	02735	CD4066AE	534078-000
U16	IC MSM5128-20-RS	52464	MSM5128-20-RS	534304-000
U17	IC MSM5128-20-RS	52464	MSM5128-20-RS	534304-000
U18	IC CD4066AE	02735	CD4066AE	534078-000
U19	IC MSM5128-20-RS	52464	MSM5128-20-RS	534304-000
U20	IC MSM5128-20-RS	52464	MSM5128-20-RS	534304-000
U21	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U22	IC CDP1855CE	02735	CDP1855CE	534302-000
U23	IC CDP1855CE	02735	CDP1855CE	534302-000
XU1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU2	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU3	Socket IC 40 Pin	06776	ICN-406-S4-G	473052-000
XU4	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU5	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU6	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU7	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU8	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU9	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000

Replaceable Parts List for PWA CPU PL 103205-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
XU10	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU11	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU12	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU13	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU14	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU15	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU16	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU17	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU18	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU19	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU20	Socket IC 24 Pin	06776	ICN-246-S4-G	473043-000
XU21	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU22	Socket IC 28 Pin	06776	ICN-286-S4-G	473044-000
XU23	Socket IC 28 Pin	06776	ICN-286-S4-G	473044-000
Y1	Crystal 2.5 MHz .01%	32897	HC-33/U 2.5MHz 0-50°C	547030-000

Replaceable Parts List for PWA Mother/Power Supply PL 102431-01J

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
B1	Cell Lithium 3V	54473	BR-2325MMLi	556007-000
C1	Capacitor EL 26000 µF 20% 16V	56289	622D263M016AC2A	283340-000
C2	Capacitor EL 26000 µF 20% 16V	56289	622D263M016AC2A	283340-000
C3	Capacitor EL 4500 µF 20% 35V	56289	622D452M035AA2A	283339-000
C4	Capacitor EL 4500 µF 20% 35V	56289	622D452M035AA2A	283339-000
C5	Capacitor EL 68 µF -10%/+100% 200V	56289	673D686H200JJ5C	283341-000
C6	Capacitor Tant 2.2 µF 20% 35V	61637	T368B225M035AS	283317-000
C7	Capacitor Tant 2.2 µF 20% 35V	61637	T368B225M035AS	283317-000
C8	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C9	Capacitor Tant 1 µF 10% 35V only	56289	196D105X9035HA1 only	283216-000
C10	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C11	Capacitor Tant 1 µF 10% 35V only	56289	196D105X9035HA1 only	283216-000
C12	Capacitor Tant 1 µF 10% 35V only	56289	196D105X9035HA1 only	283216-000
C13	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C14	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C15	Capacitor EL 4.7 µF 20% 160V	S4217	SM160T4R7M8x16LL	283354-000
C16	Capacitor EL 2300 µF -10%/+50% 60V	56289	32DR232F060AB2A	283342-000
C17	Capacitor Cer 0.01 µF 20% 50V	51406	DD350A10Y5P103M50V	224363-000
C18	Capacitor Tant 10 µF 20% 25V	56289	196D106X0025KA1	283293-000
C19	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C20	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
CR2	Diode Bridge FWLD-50	11961	FWLA-50	532028-000
CR3	Diode Bridge FWLA-200	11961	FWLA-200	532029-000
CR4	Diode Zener 1N5258B 36V	04713	1N5258B	530176-000
CR5	Diode Bridge FWLA-200	11961	FWLA-200	532029-000
CR6	Diode 1N914	01295	1N914	530058-000
CR7	Diode 1N914	01295	1N914	530058-000
J1	Header 3 Circuit Straight	06383	HPSS156-3-C	477343-000
J2	Header 2 Circuit Straight	06383	HPSS156-2-C	477342-000
J8	Header 6 Circuit	06383	HPSS156-6-C	477346-000
J9	Header 6 Circuit	06383	HPSS156-6-C	477346-000
J10	Header 5 Circuit	06383	HPSS-156-5-C	477345-000
J12	Header 3 Circuit Straight	06383	HPSS156-3-C	477343-000
J13	Header 2 Circuit Straight	06383	HPSS156-2-C	477342-000
J14	Connector Pin (male)	98291	229-1086-000-550	477240-000
J15	Connector Coaxial SMB	19505	209	477317-000
J16	Connector Coaxial SMB	19505	209	477317-000
J17	Connector Coaxial SMB	19505	209	477317-000
J18	Connector Coaxial SMB	19505	209	477317-000
J19	Connector Coaxial SMB	19505	209	477317-000
J20	Connector Coaxial SMB	19505	209	477317-000
J21	Connector Coaxial SMB	19505	209	477317-000
J22	Connector Coaxial SMB	19505	209	477317-000
J23	Connector Coaxial SMB	19505	209	477317-000
J24	Connector Pin (male)	98291	229-1086-000-550	477240-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
Q1	Transistor NPN MPS-U10	04713	MPS-U10	528097-000
Q2	Transistor NPN MPS-U10	04713	MPS-U10	528097-000
Q3	Transistor NPN MPS-U10	04713	MPS-U10	528097-000
Q4	Transistor NPN 2N3904	04713	2N3904	528071-000
Q5	Transistor PNP 2N3906	04713	2N3906	528076-000
R1	Resistor Comp 10k ohm 5% 1W	01121	GB	302125-000
R2	Resistor MF 12.1 ohm 1%	---	RN55D-12R1-F	341108-000
R3	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R4	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R5	Resistor MF 825 ohm 1%	---	RN55D-8250-F	341288-000
R6	Resistor Var 200 ohm 10% 0.5W	73138	72PR500	311304-000
R7	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R8	Resistor Var 200 ohm 10% 0.5W	73138	72PR500	311304-000
R9	Resistor Var 500 ohm 10% 0.5W	73138	72PR500	311305-000
R10	Resistor MF 121 ohm 1%	---	RN55D-1210-F	341208-000
R11	Resistor Var 1k ohm 10% 0.5W	73138	72PR1K	311316-000
R12	Resistor MF 4.02k ohm 1%	---	RN55D-4021-F	341358-000
R13	Resistor MF 2.00k ohm 1%	---	RN55D-2001-F	341329-000

TABLE 6-2. REPLACEABLE PARTS (CONT.)

Replaceable Parts List for PWA Mother/Power Supply PL 102431-01J

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R14	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R15	Resistor MF 6.81k ohm 1%	---	RN55D-6811-F	341380-000
R16	Resistor MF 22.1 ohm 1%	---	RN55D-22R1-F	341133-000
R17	Resistor MF 12.1k ohm 1%	---	RN55D-1212-F	341408-000
R18	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R19	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R20	Resistor MF 301 ohm 1%	---	RN55D-3010-F	341246-000
R21	Resistor MF 2.74k ohm 1%	---	RN55D-2741-F	341342-000
R22	Resistor Var 1k ohm 10% 0.5W	73138	72PR1K	311316-000
R23	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R24	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R25	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R26	Resistor MF 3.92k ohm 1%	---	RN55D-3921-F	341357-000
R27	Resistor MF 1.00k ohm 1%	---	RN55D-1001-F	341300-000
R28	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R29	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R30	Resistor Comp 1.0k ohm 5%	01121	EB	344300-000
R31	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R32	Resistor MF 3.01k ohm 1%	---	RN55D-3011-F	341346-000
R33	Resistor Comp 51 ohm 5% 0.25W	01121	CB	300051-000
U5	IC LF356P Op Amp	01295	LF356P/883B-00	535040-000
U6	IC 78MGU1C Regulator	07263	78MGU1C	535042-000
U7	IC 78MGU1C Regulator	07263	78MGU1C	535042-000
U8	IC LM339N Quad Comparator	27014	LM339N	535018-000
U10	IC SN74LS125N	01295	SN74LS125N	534256-000
U11	IC SN74LS160N	01295	SN74LS160N	534282-000
U12	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
XA3	Connector Receptacle (Alternate 479404)	31781	305-072-520-202	479339-000
XA4	Connector Receptacle (Alternate 479404)	31781	305-072-520-202	479339-000
XA5	Connector Receptacle (Alternate 479404)	31781	305-072-520-202	479339-000
XA6	Connector Receptacle (Alternate 479404)	31781	305-072-520-202	479339-000
XA7	Connector Receptacle (Alternate 479404)	31781	305-072-520-202	479339-000
XQ4	Socket Transistor 3 Pin	07047	90363-202	473046-000
XQ5	Socket Transistor 3 Pin	07047	90363-202	473046-000
XU5	Socket IC 8 Pin	06776	ICN-083-S3-G	473041-000
XU8	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU9	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU10	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU11	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU12	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XY1	Socket Octal 8 Pin	02660	78-S8W-0125	472133-000
Y1	Crystal 10 MHz	04901	BEC Sh.1&2	547903-000

Replaceable Parts List for PWA Keyboard PL 102446-01F

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
P1	Connector 20 Pin	27264	22003-2202 Model A-4030-A	477340-000
P2	Connector 20 Pin	27264	22003-2202 Model A-4030-A	477340-000
R1	Resistor MF 150 ohm 1%	---	RN55D-1500-F	341217-000
S1	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S2	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S3	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S4	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S5	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S6	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S7	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S8	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S9	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S10	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S11	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S12	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S13	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S14	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S15	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S16	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S17	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S18	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S19	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S20	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S21	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S22	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S23	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S24	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S25	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S26	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S27	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S28	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S29	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S30	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S31	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S32	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S33	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S34	Switch Plain	31918	200117 SE-SRU-AU	465238-000

Replaceable Parts List for PWA Keyboard PL 102446-01F

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
S35	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S36	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S37	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S38	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S39	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S40	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S41	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S42	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S43	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S44	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S45	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S46	Switch Plain	31918	200117 SE-SRU-AU	465238-000
S47	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S48	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S49	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S50	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000
S51	Switch with LED	31918	200119 SE-SRUL-RED-AU	465237-000

Replaceable Parts List for PWA Display PL 102444-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C2	Capacitor Mica 330 pF 5% 50V	20307	DM5-FY331J	205029-000
C3	Capacitor Cer 0.01 µF 10% 100V	61637	C052C103K1X5CA (MIL CK05)	224288-000
C4	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C5	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C6	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C7	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C8	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C9	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C10	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C11	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
C12	Capacitor EL 10 µF 20% 25V	S4217	SM-25-VB-10-M	283336-000
CR1	Diode 1N914	01295	1N914	530058-000
CR2	Diode 1N914	01295	1N914	530058-000
CR3	Diode 1N914	01295	1N914	530058-000
CR4	Diode 1N914	01295	1N914	530058-000
CR5	Diode 1N914	01295	1N914	530058-000
CR6	Diode 1N914	01295	1N914	530058-000
CR7	Diode 1N914	01295	1N914	530058-000
CR8	Diode 1N914	01295	1N914	530058-000
CR9	Diode 1N914	01295	1N914	530058-000
CR10	Diode 1N914	01295	1N914	530058-000
CR11	Diode 1N914	01295	1N914	530058-000
CR12	Diode 1N914	01295	1N914	530058-000
DS1	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS2	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS3	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS4	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS5	Diode Marking kHz,Hz,RAD,% M/F 536027	04901	BEC	536033-00B
DS6	Diode Marking OSC,DEV,EXT,V M/F 536027	04901	BEC	536032-00B
DS7	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS8	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS9	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS10	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS11	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS12	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS13	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS14	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS15	Diode Marking GHz,MHz,kHz,Hz M/F 536027	04901	BEC	536031-00B
DS16	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS17	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS18	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS19	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS20	Display Numeric 5082-7651 (C or D Only)	28480	5082-7651	536811-000
DS21	Diode Marking dBm,PGM,ADR,dBµV M/F536027	04901	BEC	536030-00C
DS22	Diode Marking V,mV,µV,nV M/F 536027	04901	BEC	536029-00B
DS23	Diode Mark REM,LSN,TKL,SRQ M/F536027,039	04901	BEC	536028-00C
J1	Connector 20 Pin	27264	22-02-2201 Model 4455-C	479399-000
J2	Connector 20 Pin	27264	22-02-2201 Model 4455-C	479399-000
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J4	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
J6	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
J7	Header 5 Circuit Rt Angle	06383	HPAS156-5-C	477341-000
R1	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R2	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R3	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R4	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R5	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R6	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R7	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000

Replaceable Parts List for PWA Display PL 102444-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
R8	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R9	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R10	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R11	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R12	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R13	Resistor MF 26.7k ohm 1%	---	RN55D-2672-F	341441-000
R14	Resistor MF 51.1k ohm 1%	---	RN55D-5112-F	341468-000
R15	Resistor Network 10k ohm 2%	73138	898-3-R10K	345012-000
R16	Resistor MF 5.11k ohm 1%	---	RN55D-5111-F	341368-000
R17	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R18	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R19	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R20	Resistor MF 100k ohm 1%	---	RN55D-1003-F	341500-000
R21	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
R22	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R23	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R24	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R25	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R26	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
R27	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R28	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R29	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R30	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R31	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R32	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R33	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R34	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R35	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
R36	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R37	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R38	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R39	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R40	Resistor Network 330 ohm 2% 1.5W	73138	898-3-R330	345027-000
R41	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
R42	Resistor Network 150 ohm 2% 1.5W	73138	898-3-R150	345026-000
U1	IC LM324N Op Amp	27014	LM324N	535068-000
U2	IC 74LS148N 8 to 3 Encoder	01295	SN74LS148N	534234-000
U3	IC SN74LS279N	01295	SN74LS279N	534236-000
U4	IC LM324N Op Amp	27014	LM324N	535068-000
U5	IC SN74LS279N	01295	SN74LS279N	534236-000
U6	IC 74LS148N 8 to 3 Encoder	01295	SN74LS148N	534234-000
U7	IC SN74LS132N	01295	SN74LS132N	534102-000
U8	IC SN74LS74N	01295	SN74LS74N	534157-000
U9	IC SN74123N	01295	SN74123N	534071-000
U10	IC Am25LS2538	34335	Am25LS2538	534245-000
U11	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U12	IC Am25LS2538	34335	Am25LS2538	534245-000
U13	IC Am25LS2538	34335	Am25LS2538	534245-000
U14	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U15	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U16	IC SN74LS145AN	01295	SN74LS145AN	534258-000
U17	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U18	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U19	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U20	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U21	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U22	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U23	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U24	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U25	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U26	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U27	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U28	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U29	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U30	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U31	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U32	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U33	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U34	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U35	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U36	IC SN74LS373N	01295	IC SN74LS373N	534237-000
U37	IC SN74LS373N	01295	IC SN74LS373N	534237-000
XDS1	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS2	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS3	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS4	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS5	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XDS6	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XDS7	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS8	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS9	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS10	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS11	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000

Replaceable Parts List for PWA Display PL 102444-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
XDS12	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS13	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS14	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS15	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XDS16	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS17	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS18	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS19	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS20	Socket IC 14 Pin WW	06776	ICN-143-WB-G	473066-000
XDS21	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XDS22	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XDS23	Socket IC 16 Pin WW	06776	ICN-163-WB3-G	473047-000
XU1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU4	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU5	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU6	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU7	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU8	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU9	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU10	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU11	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU12	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU13	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU14	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU15	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU16	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XU17	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU18	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU19	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU20	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU21	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU22	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU23	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU24	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU25	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU26	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU27	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU28	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU29	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU30	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU31	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU32	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU33	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU34	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU35	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU36	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000
XU37	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000

Replaceable Parts List for Rear/Left Side Assembly PL 102448-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
CR1	Diode Bridge SDA-980-1	11961	SDA-980-1	532030-000
F1	Fuse 2 A 3AG	75915	3AG	545541-000
F1	Fuse 1 Amp	54426	AGC-1	545500-000
F2	Fuse .25 A Slo-Blo	54426	MDL 1/4 Slo-Blo	545511-000
F2	Fuse 0.5 A Slo-Blo	54426	MDL	545504-000
FL1	Filter Line	56289	2JX5421A	439004-000
J7	Connector BNC	54420	UG-625/U	479123-000
J8	Connector 50 ohm	19505	17-0219-000	477305-000
J9	Connector BNC	54420	UG-625/U	479123-000
J10	Connector BNC	54420	UG-625/U	479123-000
J11	Connector BNC	54420	UG-625/U	479123-000
K1	Relay	08077	S228	471043-000
S1	Switch DPDT	82389	46206LFR	465233-000
S2	Switch DPDT-DPDT	82389	46227LFR	465234-000
S4	Switch Slide	79727	GF-124	465171-000
T1	Transformer Power	04901	BEC	446090-00E
T2	Transformer Power	08779	DP241-6-48	446089-000
XF1	Fuse Holder Body	17801	FEU 031.1666s	482113-000
XF2	Fuse Holder Body	17801	FEU 031.1666s	482113-000

Replaceable Parts List for Heatsink Assembly PL 102449-01C

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
U1	IC 78HGASC Voltage Regulator	07263	μA78HGASC	535080-000
U2	IC μA79HGKC Voltage Regulator	07263	μA79HGKC	535081-000
U3	IC 78HGASC Voltage Regulator	07263	μA78HGASC	535080-000
U4	IC μA79HGKC Voltage Regulator	07263	μA79HGKC	535081-000

Replaceable Parts List for Cable Assembly PL 102451-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
J1	Connector 3 Circuit	06383	CE156F22-3-C	479406-000
J2	Connector 2 Circuit	06383	CE156F22-2-C	479405-000
J12	Connector 3 Circuit	06383	CE156F22-3-C	479406-000
J13	Connector 2 Circuit	06383	CE156F22-2-C	479405-000
W3	Cable Assembly Coaxial	53919	PE3428-18	572051-000
W4	Cable Assembly Coaxial	53919	PE3428-18	572051-000
W5	Cable Assembly Coaxial	53919	PE3428-18	572051-000
W6	Cable Unit (FM to Oscillator Housing)	04901	BEC	572075-00A
W11	Cable Unit (AM to RF #2)	04901	BEC	572074-00A
W12	Cable Assy (RF Housing #2 to Mother)	04901	BEC	571171-00A
W13	Cable Unit (Mother to RF #2)	04901	BEC	572077-00A
W14	Cable Unit (Mother to RF #1)	04901	BEC	572076-00A
W23	Cable Assembly (Power Display)	04901	BEC	571168-00A
W24	Cable Unit (Front Panel to Mother)	04901	BEC	572078-00A
W25	Cable Unit (Front Panel to Mother)	04901	BEC	572079-00A
W26	Cable Unit (Front Panel to Mother)	04901	BEC	572080-00A
W27	Cable Assy (Mother to Rear Panel Switch)	04901	BEC	571167-00A
W28	Cable Assy (Mother to Rear Panel)	04901	BEC	572081-00A
W29	Cable Assembly (Knob to Front Panel)	04901	BEC	571169-00B
W30	Cable Unit (Mother to Rear Outside)	04901	BEC	572082-00A
W31	Cable Unit (Mother to Rear)	04901	BEC	572083-00A
W32	Cable Unit (Mother to Rear)	04901	BEC	572084-00A

Replaceable Parts List for Flat Cable Assembly PL 102450-01B

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
W7	Cable Unit (FM to RF #1)	04901	BEC	920084-00A
W8	Cable Unit (AM to Attenuator)	04901	BEC	920069-00A
W9	Cable Unit (AM to RF #2)	04901	BEC	920080-00A
W10	Cable Unit (AM to RF #2)	04901	BEC	920082-00A
W16	Cable Unit (I/O to RF #2)	04901	BEC	920078-00A
W17	Cable Unit (I/O to RF #2)	04901	BEC	920076-00A
W18	Cable Unit (I/O to Rear Panel)	04901	BEC	920088-00A
W19	Cable Unit Auxillary (Rear PL to I/O)	04901	BEC	920086-00A
W20	Cable Unit (I/O to Display)	04901	BEC	920073-00A
W21	Cable Unit (I/O to Display)	04901	BEC	920071-00A
W22	Cable Unit (I/O to Display)	04901	BEC	920074-00A

Replaceable Parts List for Line Filter Assembly PL 102452-01B

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
C2	Capacitor Cer Ft 100 pF 10% 250V	04222	7404-Y5P-101k	227120-000
L1	Inductor 10 µH 10%	24226	10/102	400361-000

Replaceable Parts List for PWA RF Filter Connector PL 102453-01D

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
A2J11	Connector Pin (male)	98291	229-1086-000-550	477240-000
XA2J1	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
XA2J2	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000

Replaceable Parts List for Attenuator (Alan) Assembly PL 102454-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
U1	Attenuator RF (Alan)	52750	50DA156-162	562010-000

Replaceable Parts List for Attenuator (Weinschel) Assembly PL 102466-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
J3	Socket IC 16 Pin	06776	ICN-163-S3-G	473042-000
U1	Attenuator RF	04901	BEC (Weinschel)	562009-00A

Replaceable Parts List for Frame Assembly PL 103201-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
W2	Cable Unit (Attenuator to RF Housing)	04901	BEC	572086-00A
W33P1	Connector Female	27264	Reel #02-06-1231	479320-000
W33P2	Connector Female	27264	Reel #02-06-1231	479320-000

Replaceable Parts List for Front Panel Assembly PL 103202-000

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
A9	PWA Display	04901	BEC	102444-01D
A10	PWA Keyboard	04901	BEC	102446-01F
J2	Connector BNC	54420	UG-625/U	479123-000
J3	Connector BNC	54420	UG-625/U	479123-000
J4	Connector BNC	54420	UG-625/U	479123-000
S3	Switch Power	95146	MDS-106D-60-9	465232-000
U1	Rotaswitch			483238-000
XF3	Connector Mounting Block Unit	04901	BEC	720935-00A

Replaceable Parts List for Mother Board Bracket Rear Unit FL 730789-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	REC Part No.
J7	Connector BNC	54420	UG-625/U	479123-000
J9	Connector BNC	54420	UG-625/U	479123-000
J10	Connector BNC	54420	UG-625/U	479123-000
J11	Connector BNC	54420	UG-625/U	479123-000

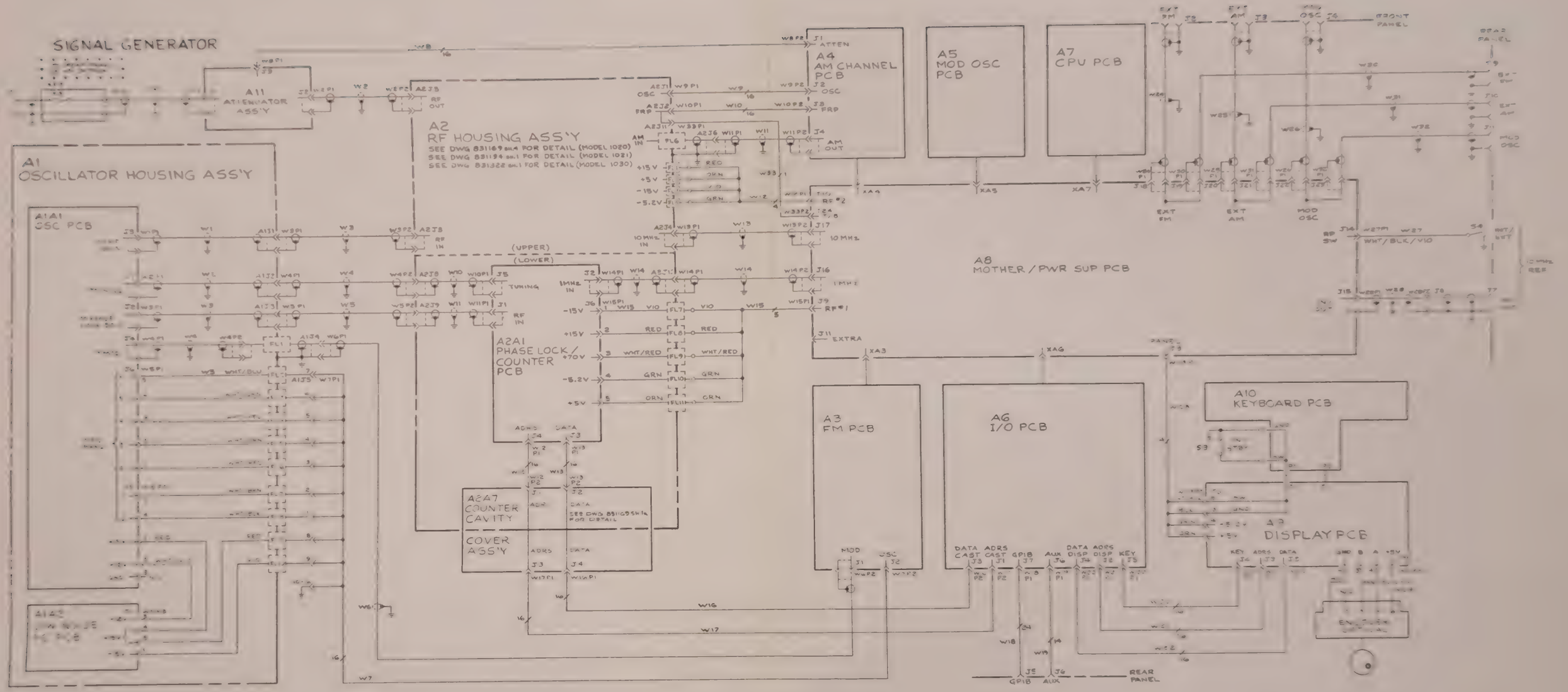


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Figure 7-1. Signal Generator Schematic Diagram

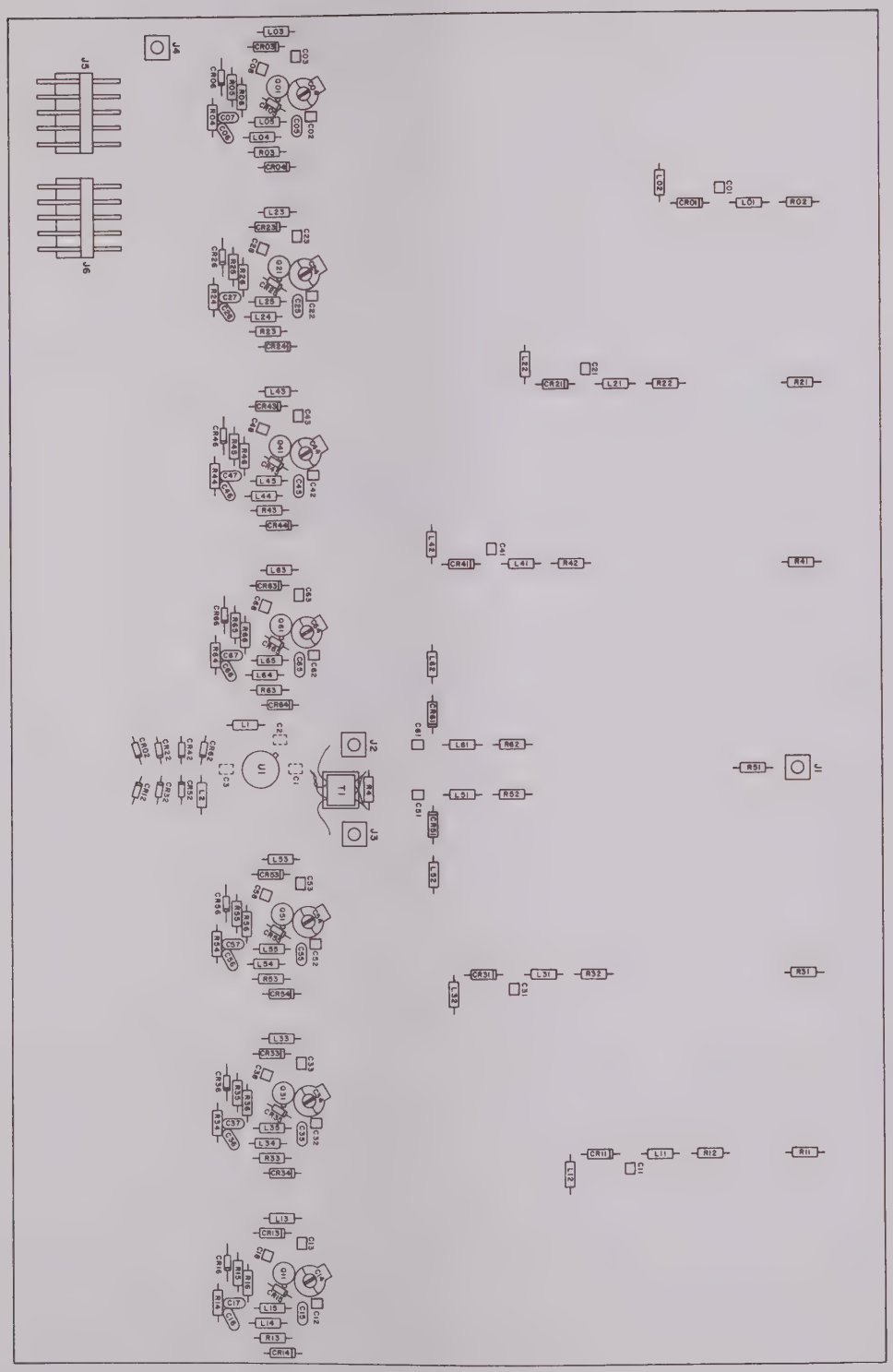

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Figure 7-2. A1 Oscillator
Overlay Diagram

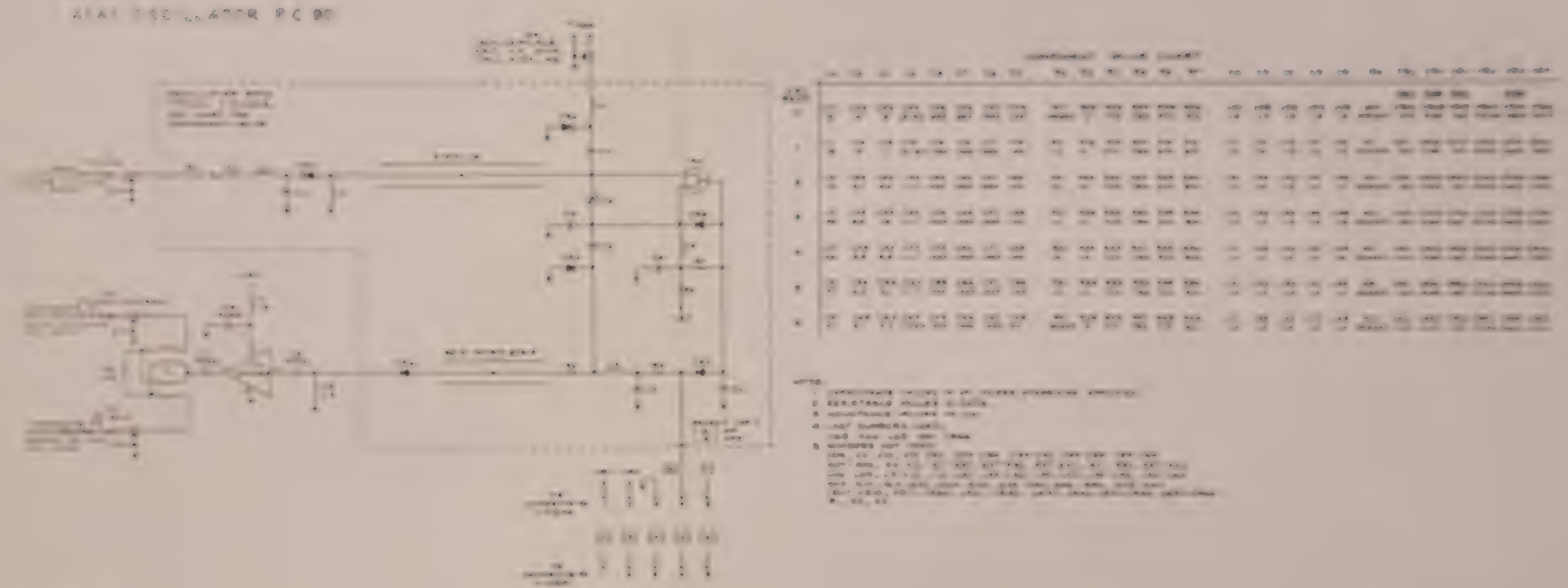
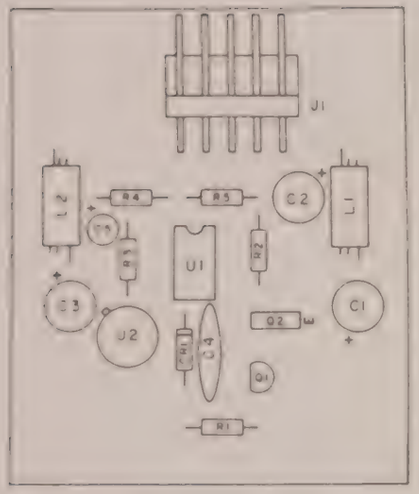


Figure 7-1. AT&T Oscillator
Schematic Diagram

A1A2 LOW NOISE PWR SUPPLY P.C. BD.



831174A

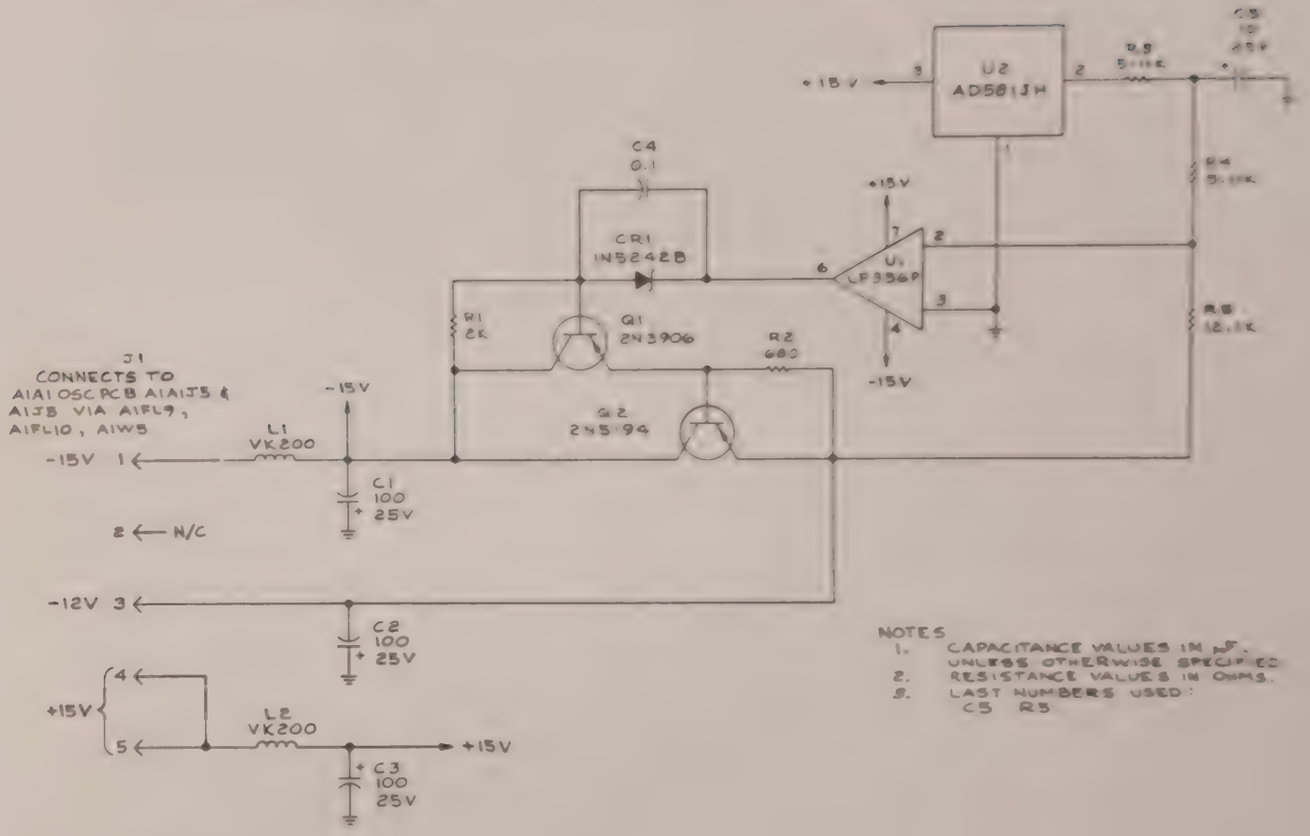


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Figure 7-4. A1A2 Low Noise PWR Supply Schematic Diagram

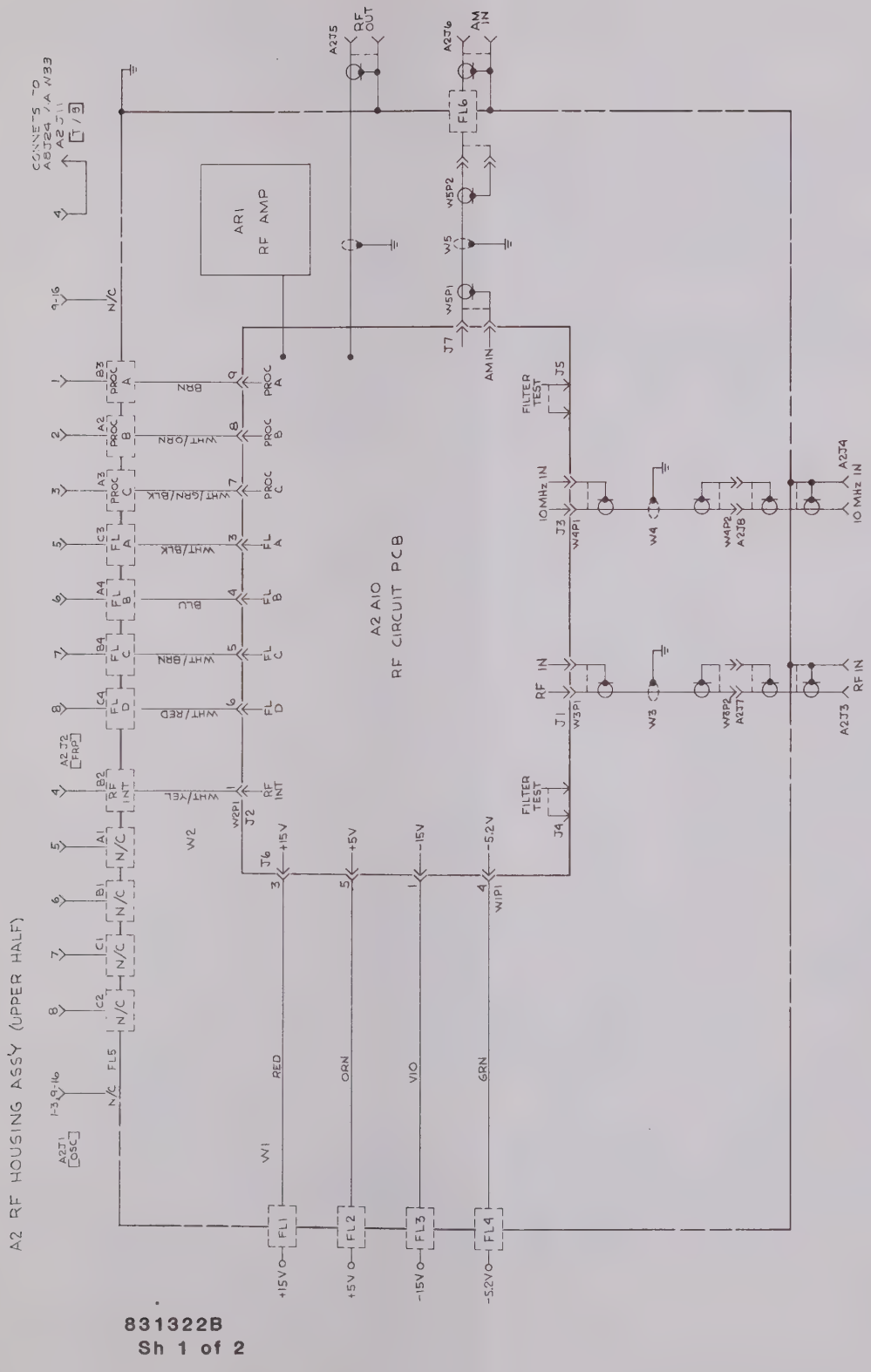


Figure 7-5. A2 RF Housing Assembly (Upper Half) Schematic Diagram

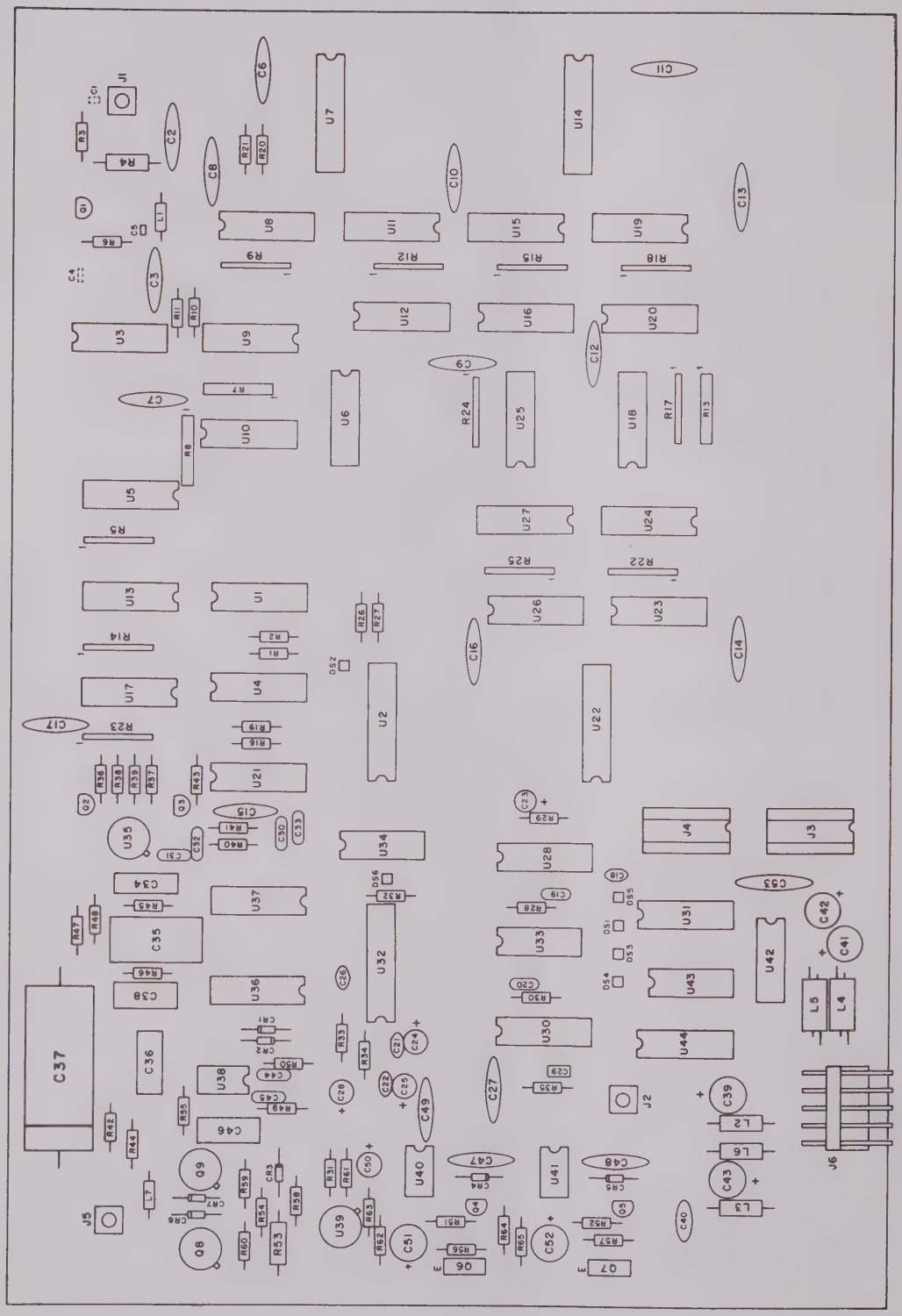
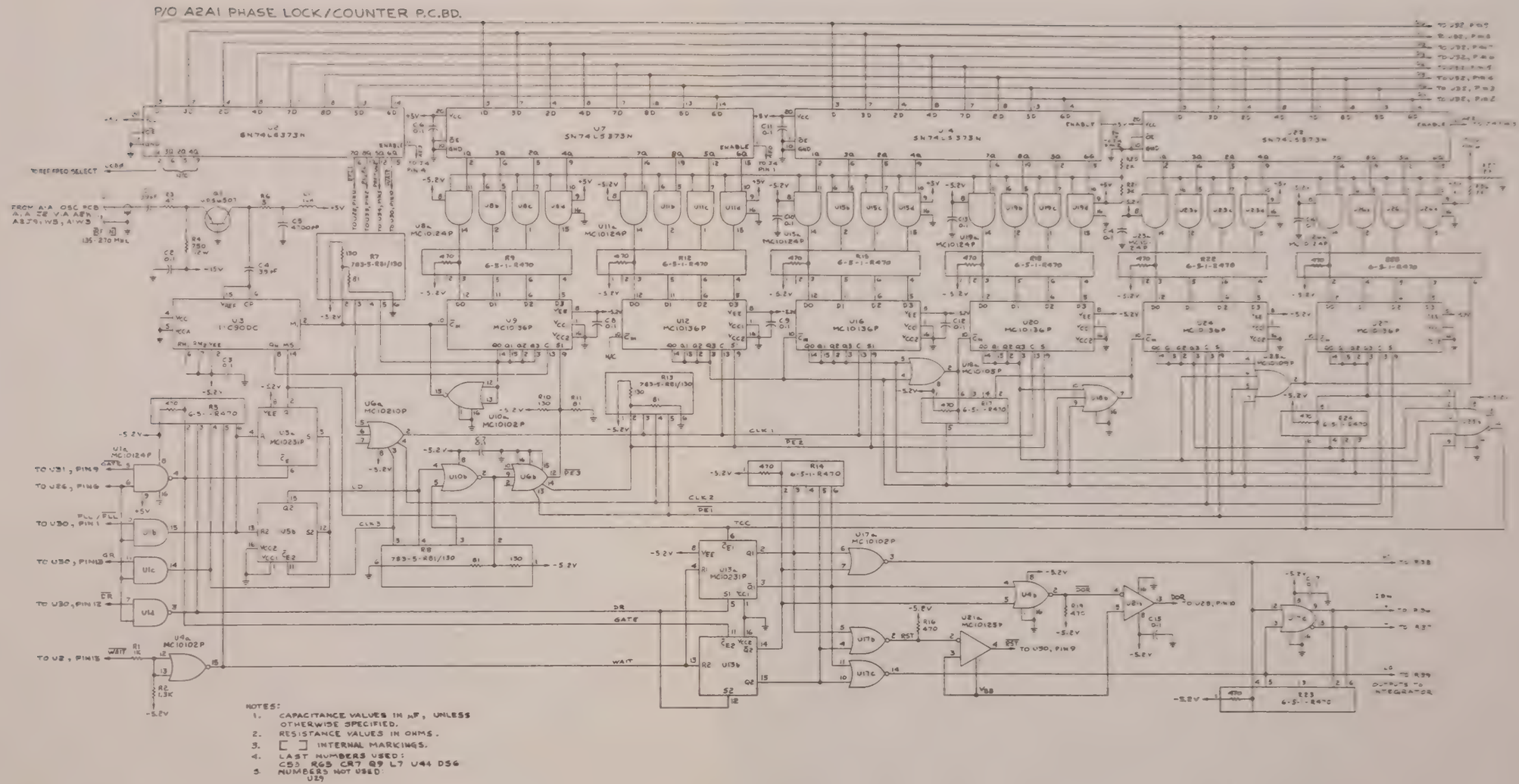


Figure 7-6. A2A1 Phase Lock/Counter Overlay Diagram


P/O A2A1 PHASE LOCK/COUNTER P.C.BD.
FROM A1A OSC PCB A1A2E2 V A AB1 A2791W3, A1W3
135-270 MHz
TO REF FREQ SELECT
U6 SN74LS373N
U7 SN74LS373N
U4 SN74LS373N
U5 SN74LS373N
U8a MC10124P
U11a MC10124P
U15a MC10124P
U19a MC10124P
U3 1:C90DC
U9 MC10136P
U12 MC10136P
U16 MC10136P
U20 MC10136P
U24 MC10136P
U27 MC10136P
U6a MC10210P
U10a MC10102P
U13a MC10231P
U17a MC10102P
U21a MC10123P
U9a MC10102P
U1a MC10124P
U1b
U1c
U1d
U4b
U17b
U17c
U18a MC10105P
U18b
U18c
U18d
U22a MC10109P
U26a MC10109P
R1 1K
R2 1.3K
R3 6-5-1-R470
R4 750 2W
R5 6-5-1-R470
R6 5
R7 783-5-R81/130
R8 783-5-R81/130
R9 6-5-1-R470
R10 130
R11 81
R12 6-5-1-R470
R13 783-5-R81/130
R14 6-5-1-R470
R15 6-5-1-R470
R16 470
R17 6-5-1-R470
R18 6-5-1-R470
R19 470
R20 2K
R21 2K
R22 6-5-1-R470
R23 6-5-1-R470
R24 6-5-1-R470
C1 0.1
C2 0.1
C3 0.1
C4 39pF
C5 4700pF
C6 0.1
C7 0.1
C8 0.1
C9 0.1
C10 0.1
C11 0.1
C12 0.1
C13 0.1
C14 0.1
C15 0.1
Q1 2N3507
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
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Q34
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Q36
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Q38
Q39
Q40
Q41

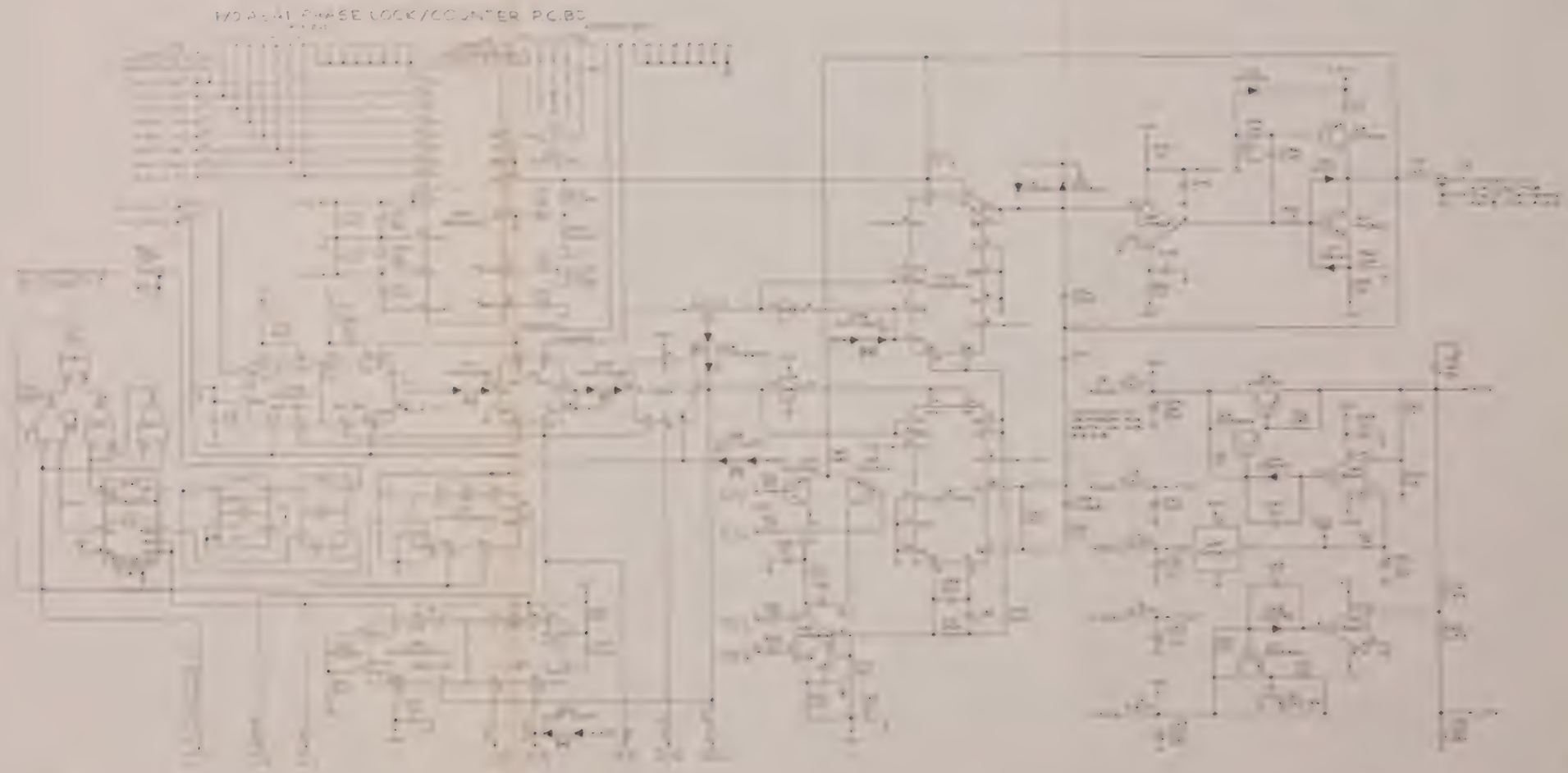

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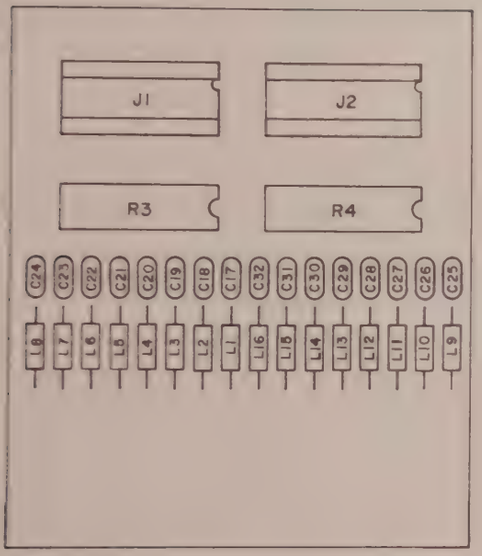
Figure 7-8. A2A1 Phase Lock/Counter Schematic Diagram (Sh 2)



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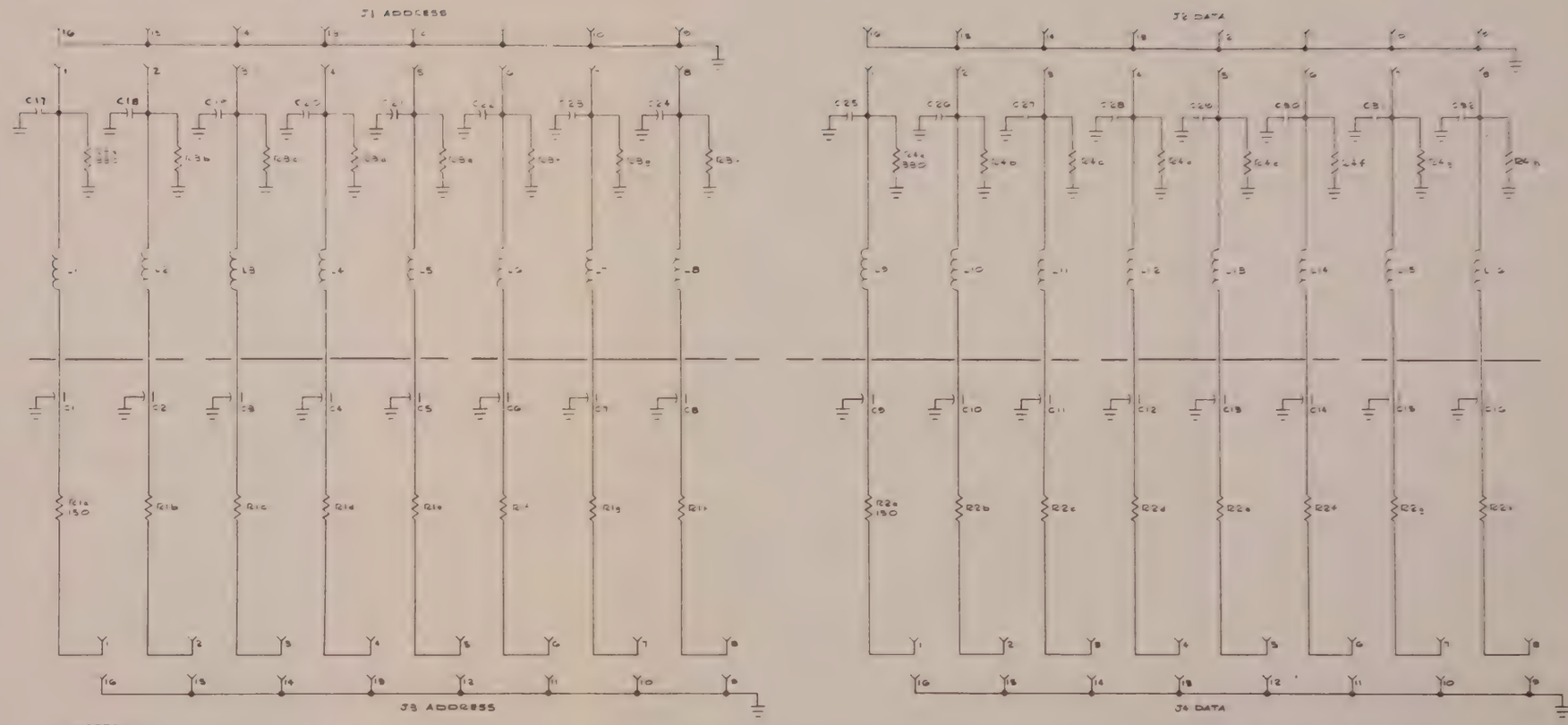
A2 A7 COUNTER CAVITY COVER ASSY.



NOTES:
1. RESISTANCE VALUES IN OHMS
2. CAPACITORS C17 TO C32 INCLUSIVE 100pF 5%, 300V
3. CAPACITORS C1 TO C16 INCLUSIVE 100pF 20%, 250V
4. INDUCTORS L1 TO L16 INCLUSIVE 10μH
5. LAST NUMBERS USED C32, L16, R4

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Figure 7-9. A2A7 Counter Cavity Cover Assembly Schematic Diagram

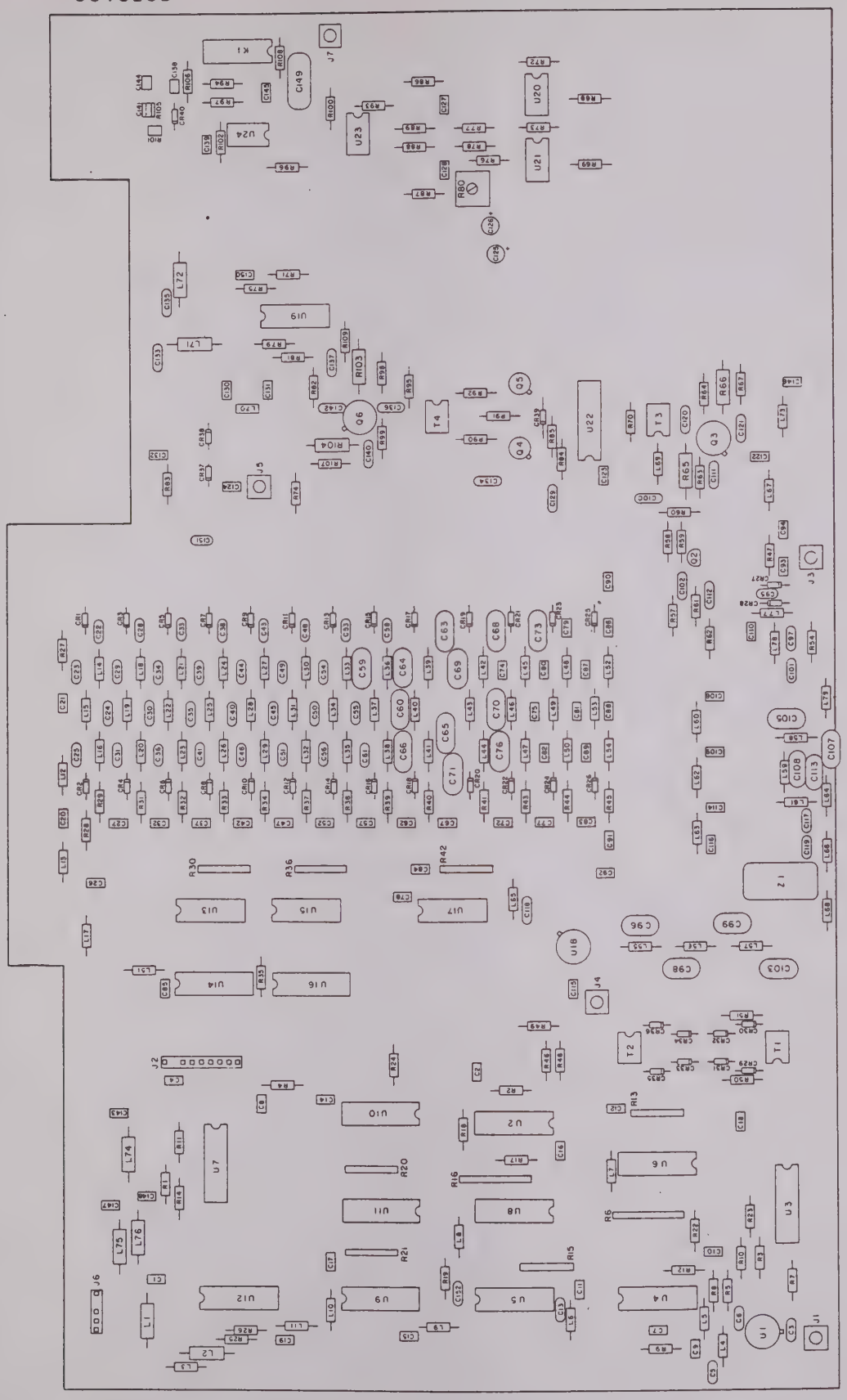
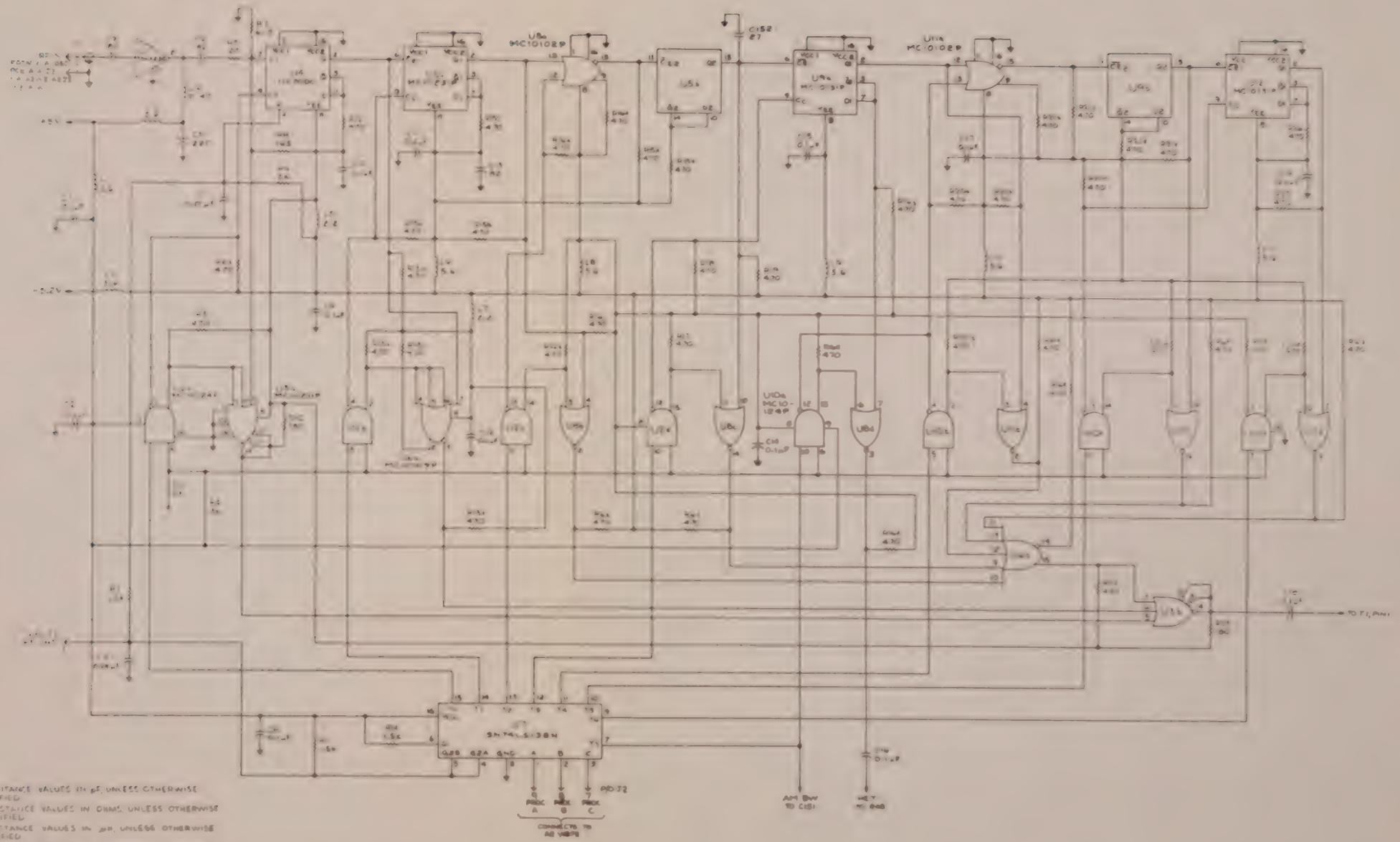


Figure 7-10. A2A10 RF
Overlay Diagram

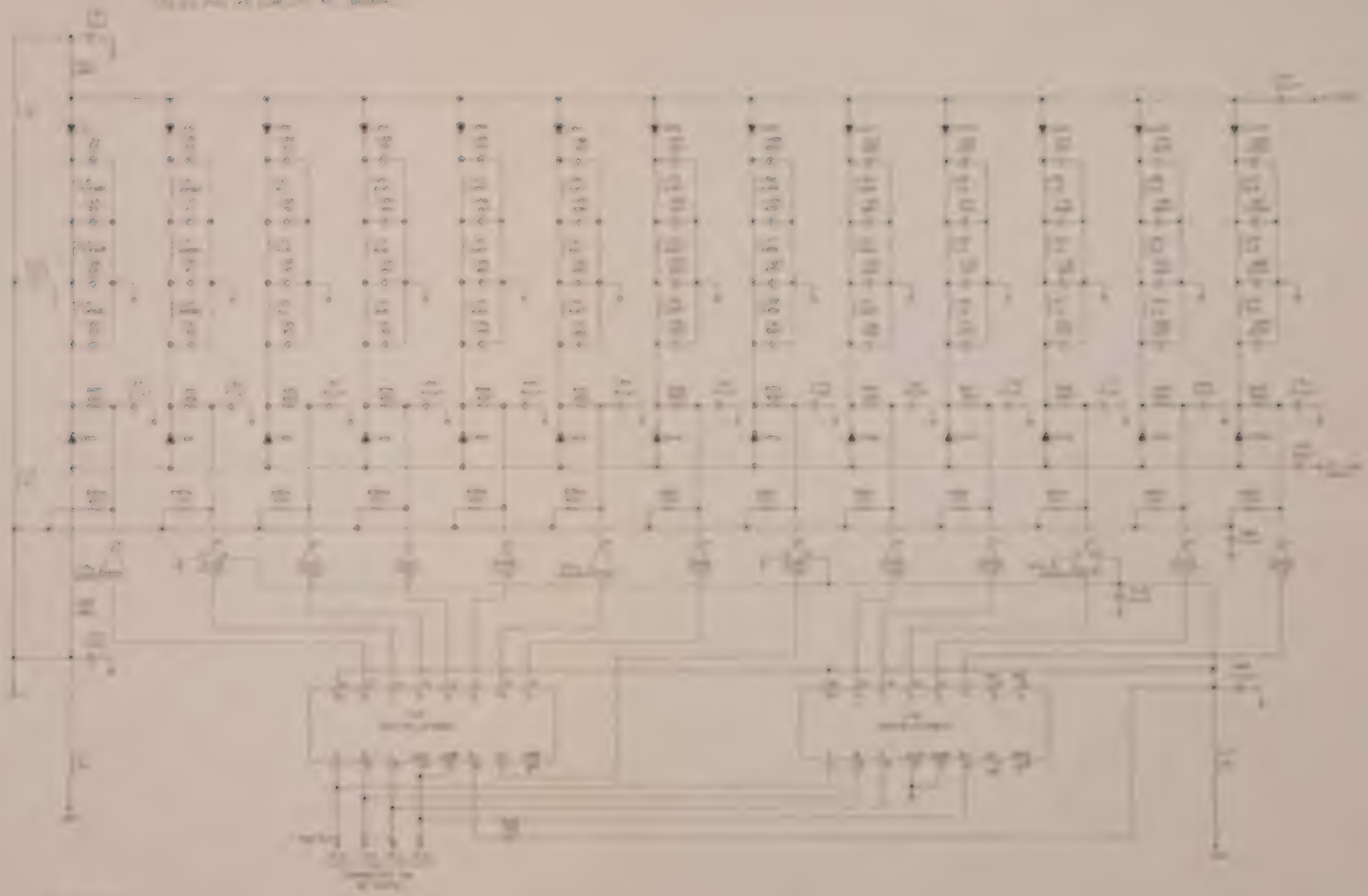
P/O A2 A10 RF CIRCUIT P.C. BOARD



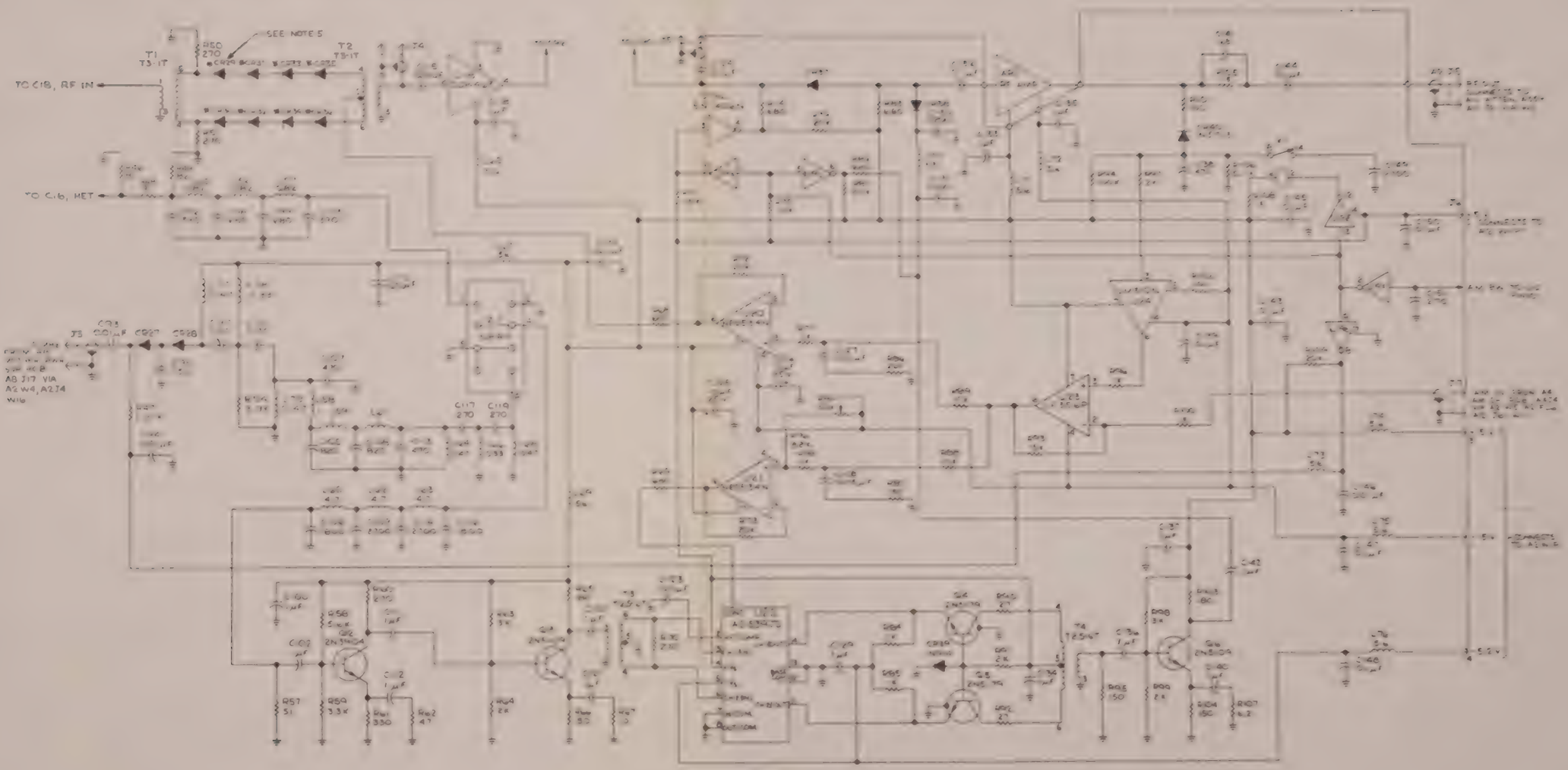
NOTES:
1. CAPACITANCE VALUES IN pF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS, UNLESS OTHERWISE SPECIFIED.
3. INDUCTANCE VALUES IN μH, UNLESS OTHERWISE SPECIFIED.
4. ALL DIODES TO BE TYPE HP5082-3188, UNLESS OTHERWISE SPECIFIED.
5. DIODES CR25 THRU CR34 TO BE TYPE MATCHED SET 5082-3188 PRS 1 OR 4 (MARKED BY ■)
6. LAST NUMBERS USED
   R101, C152, CR40, U24, L79, Q6
7. NUMBERS NOT USED
   R58, R83, R88, R96
   Q1, C104

831322B
Sh 2a of 2

Figure 7-11. A2A10 RF Schematic Diagram (Sh 1)



P/O A2 A10 RF CIRCUIT P.C. BOARD



831322B
Sh 2c of 2

Figure 7-13. A2A10 RF Schematic Diagram (Sh 3)

P/O A3 FM P.C.BD.

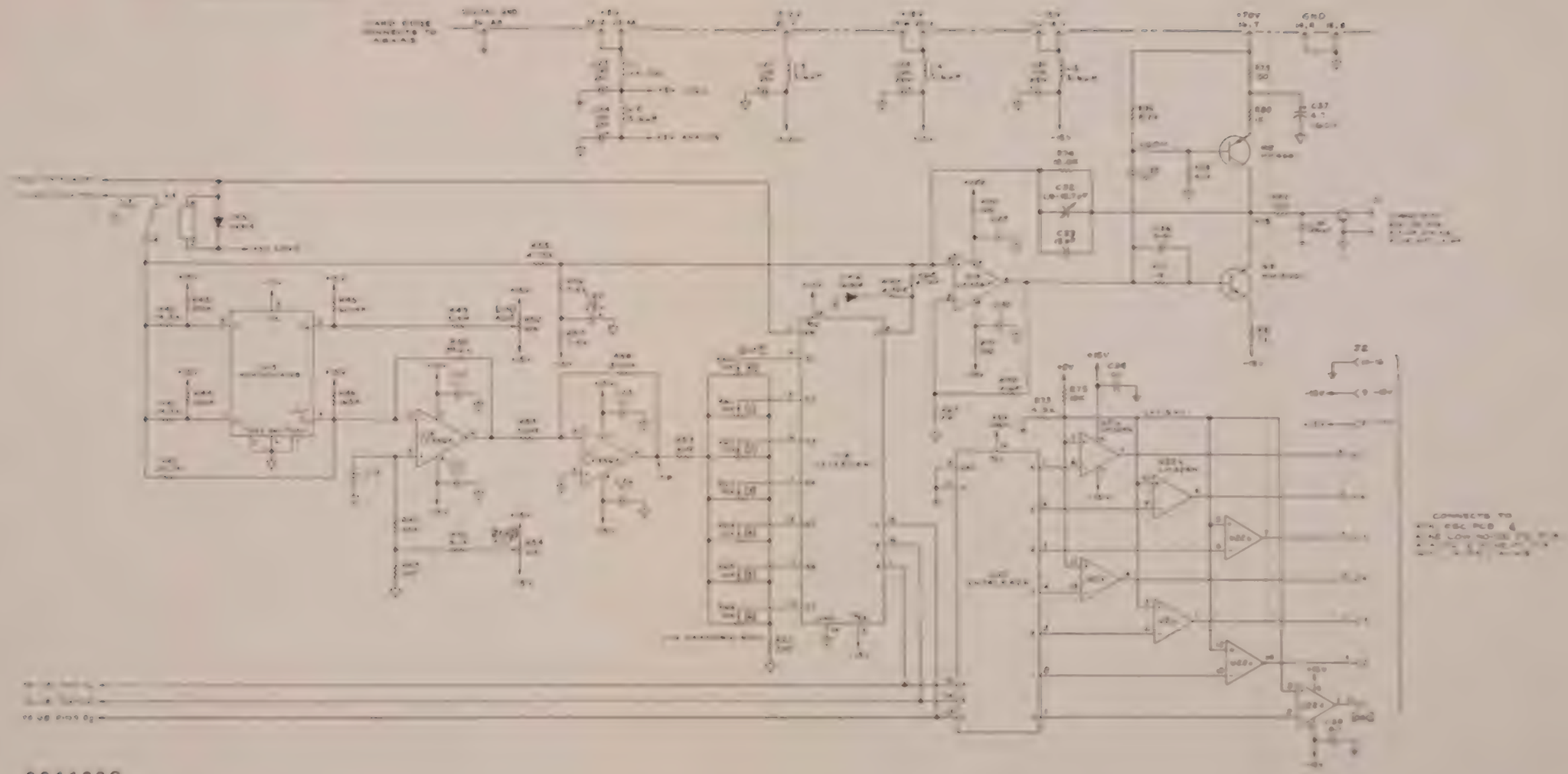
831186E

831169G
Sh 12a of 18

NOTES:
1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS.
3. [ ] INTERNAL MARKINGS.
4. LAST NUMBERS USED:
   C38 R85 CR6 U22 L5
5. NOT USED ON OPTION -07 HIGH IMPEDANCE MOD INPUTS
6. NUMBERS NOT USED:
   R93
7. USED ON 1030 ONLY.

Figure 7-14. A3 FM Schematic Diagram (Sh 1)

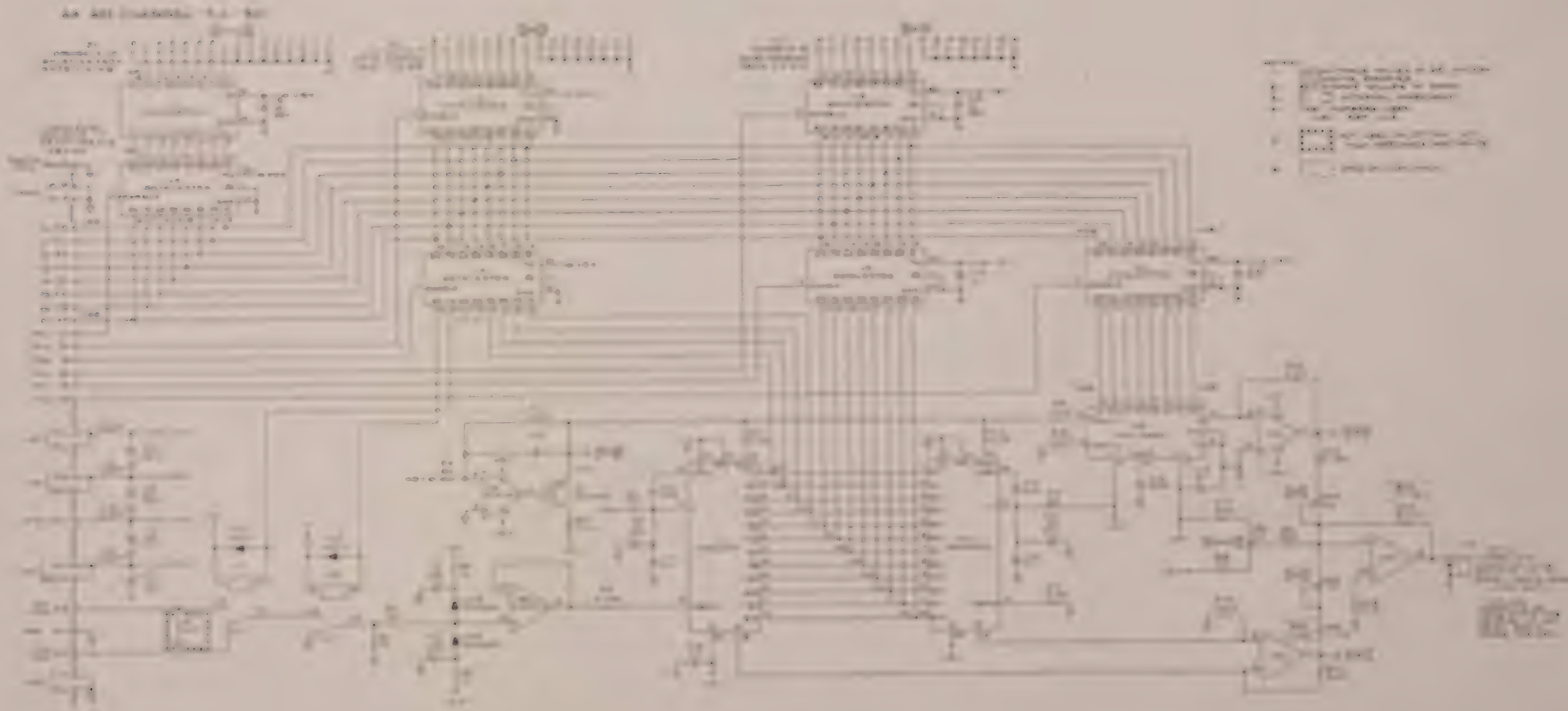
P/O A3 FM P.C.BD.



831169G
Sh 12b of 18

Figure 7-15. A3 FM
Schematic Diagram (Sh 2)

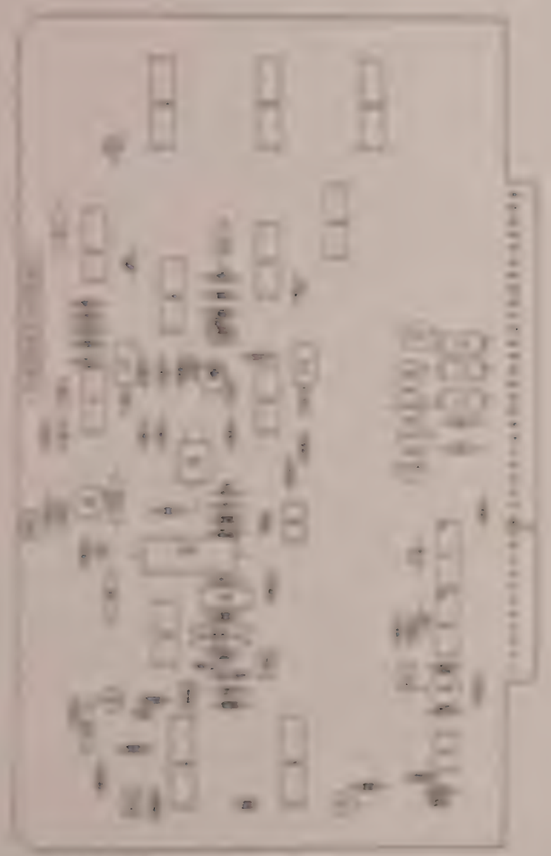
031104A



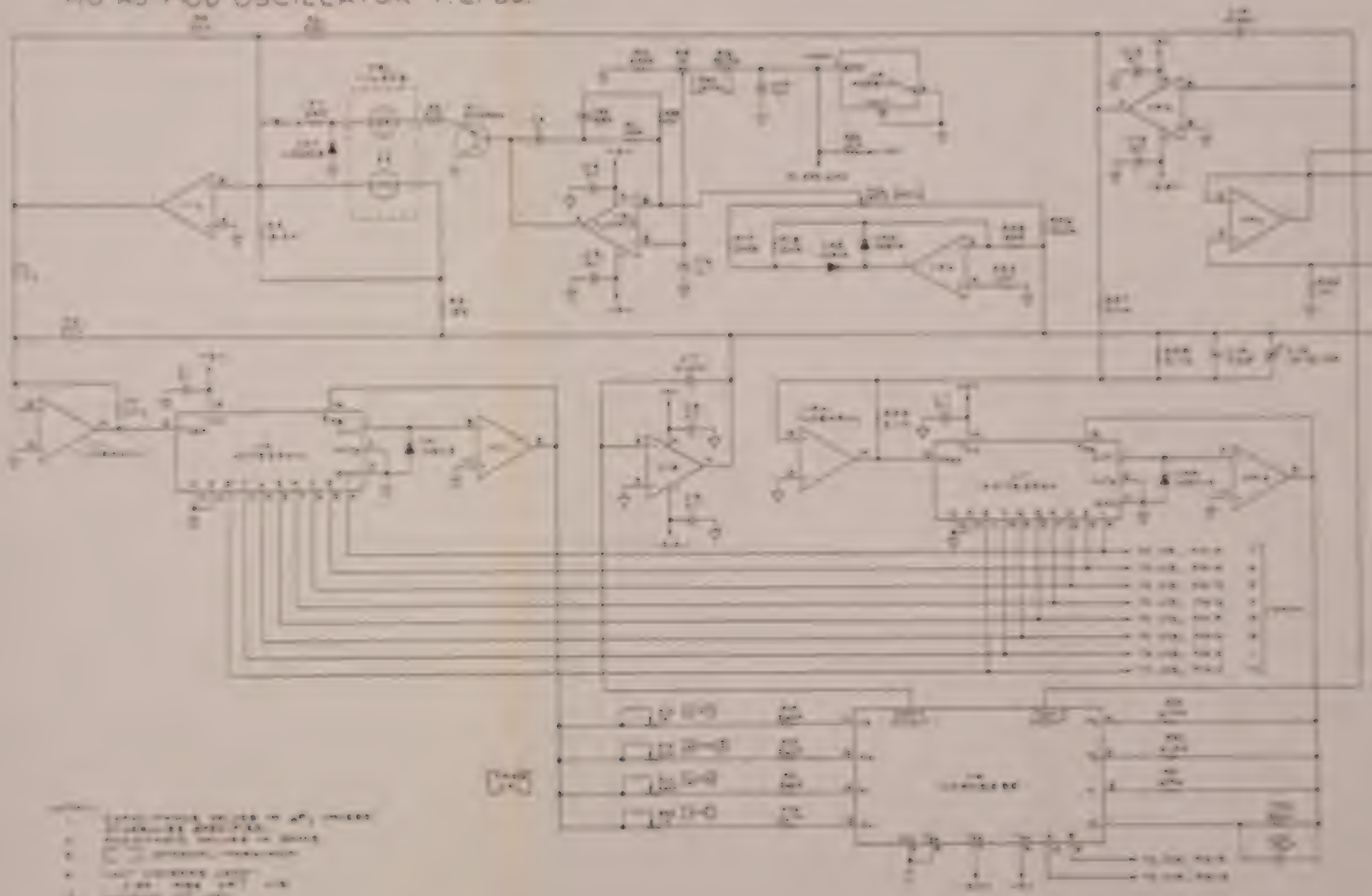
031104F
Sh 10 of 10

Figure 7-16. A4 AM Channel Schematic Diagram

P/O A3 MOD OSCILLATOR P.C. BD.



A311070

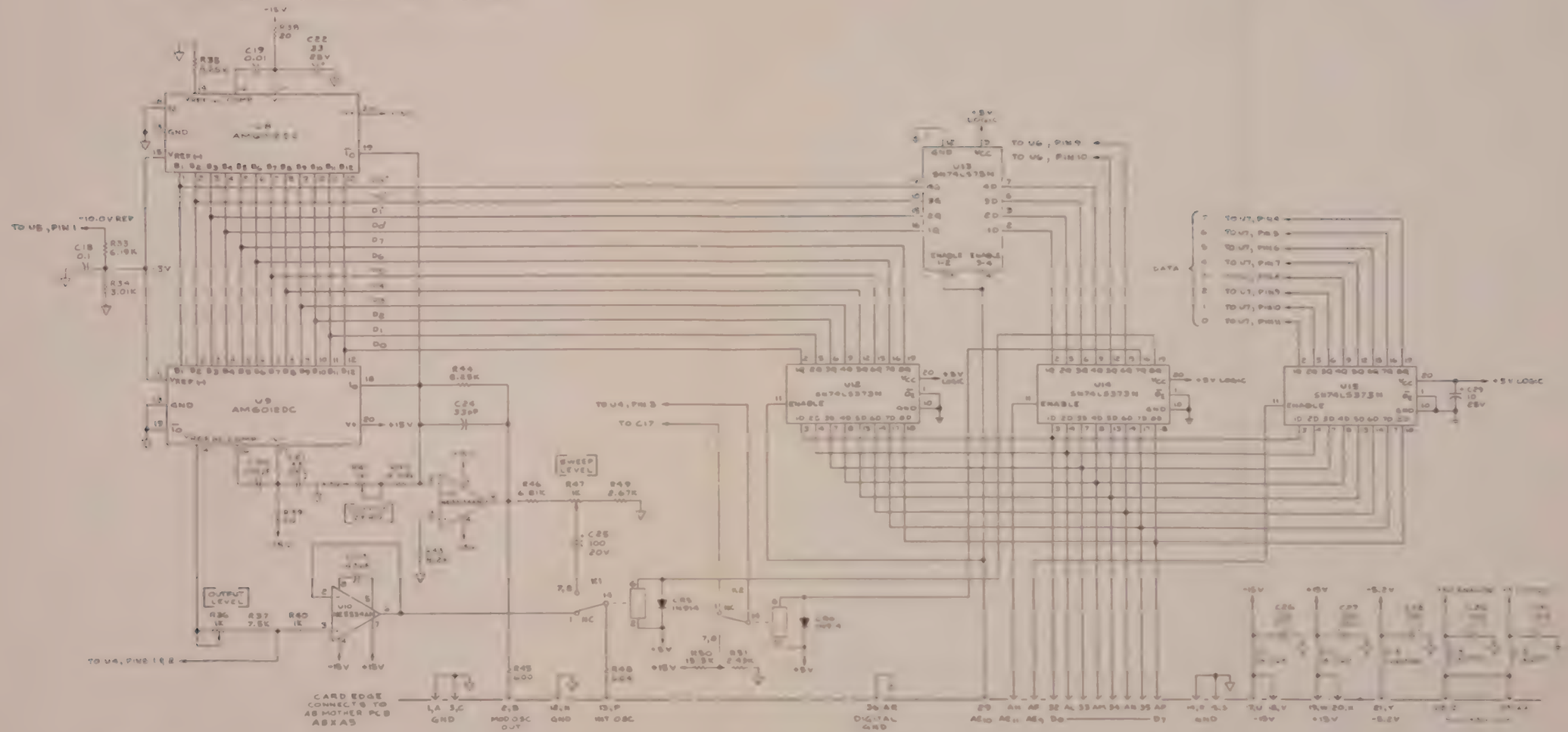


A311100E
Sh 1 of 10

Figure 5-17. MOD Oscillator
Schematic Diagram (Sh 1)

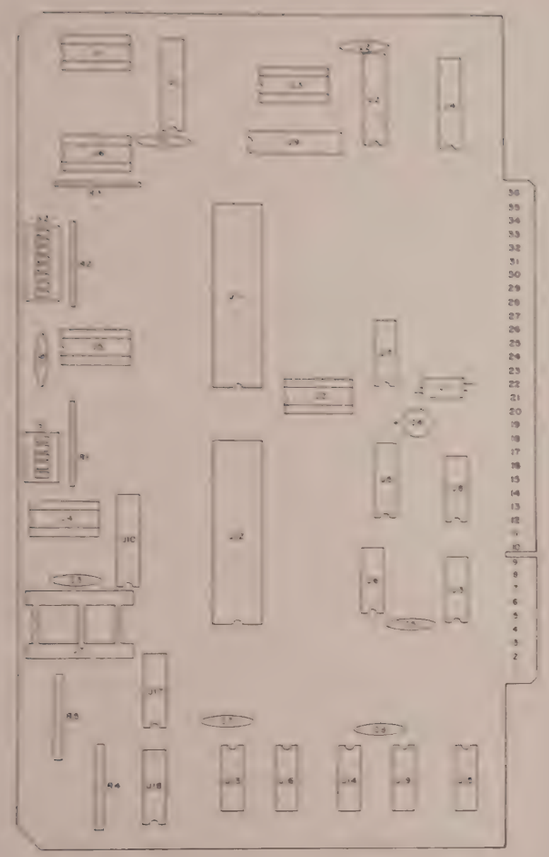
5-67

P/O A5 MOD OSCILLATOR P.C. BD.

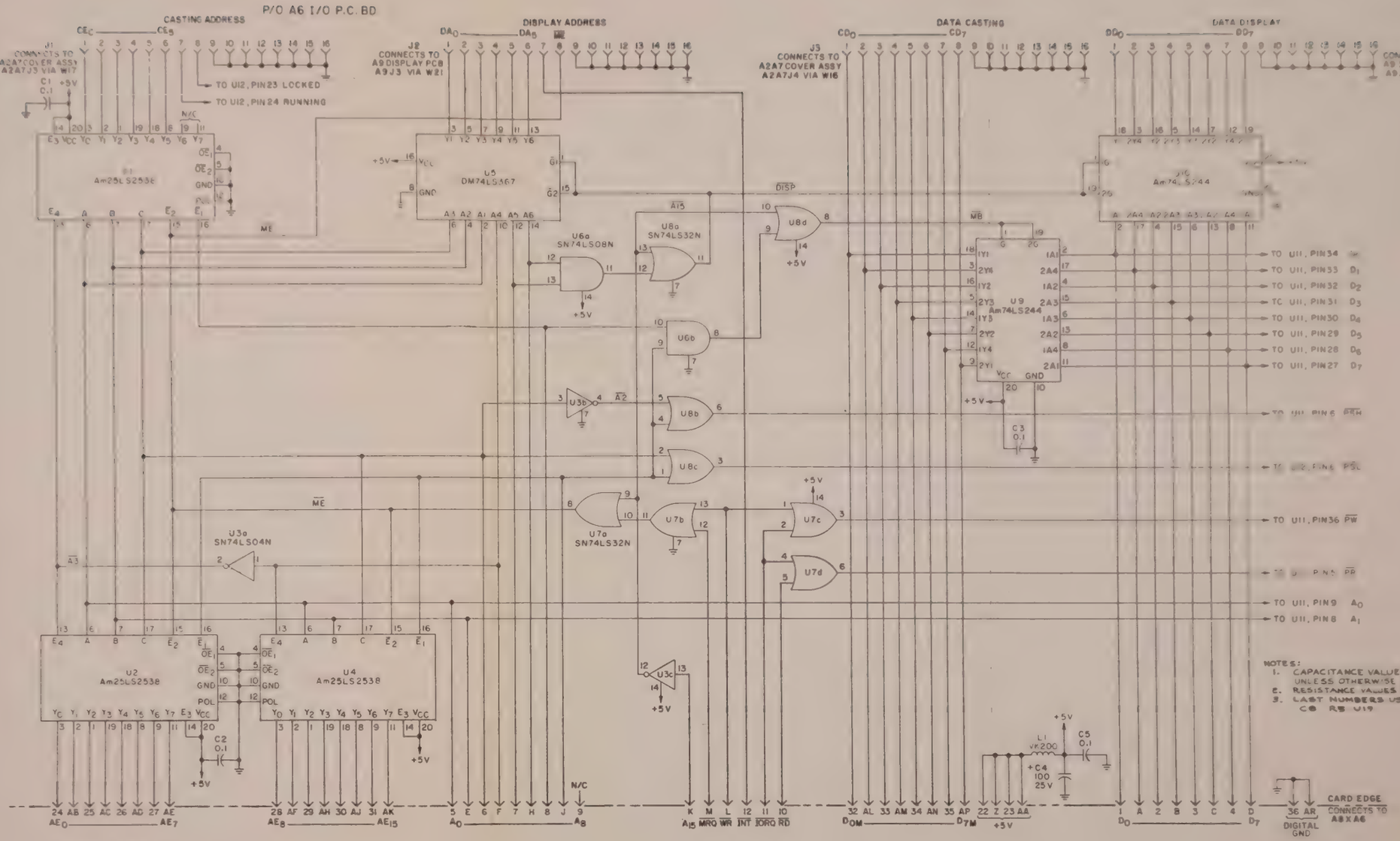


831169D
Sh 15b of 18

Figure 7-18. MOD Oscillator Schematic Diagram (Sh 2)



831185A



831169B
Sh 14a of 18

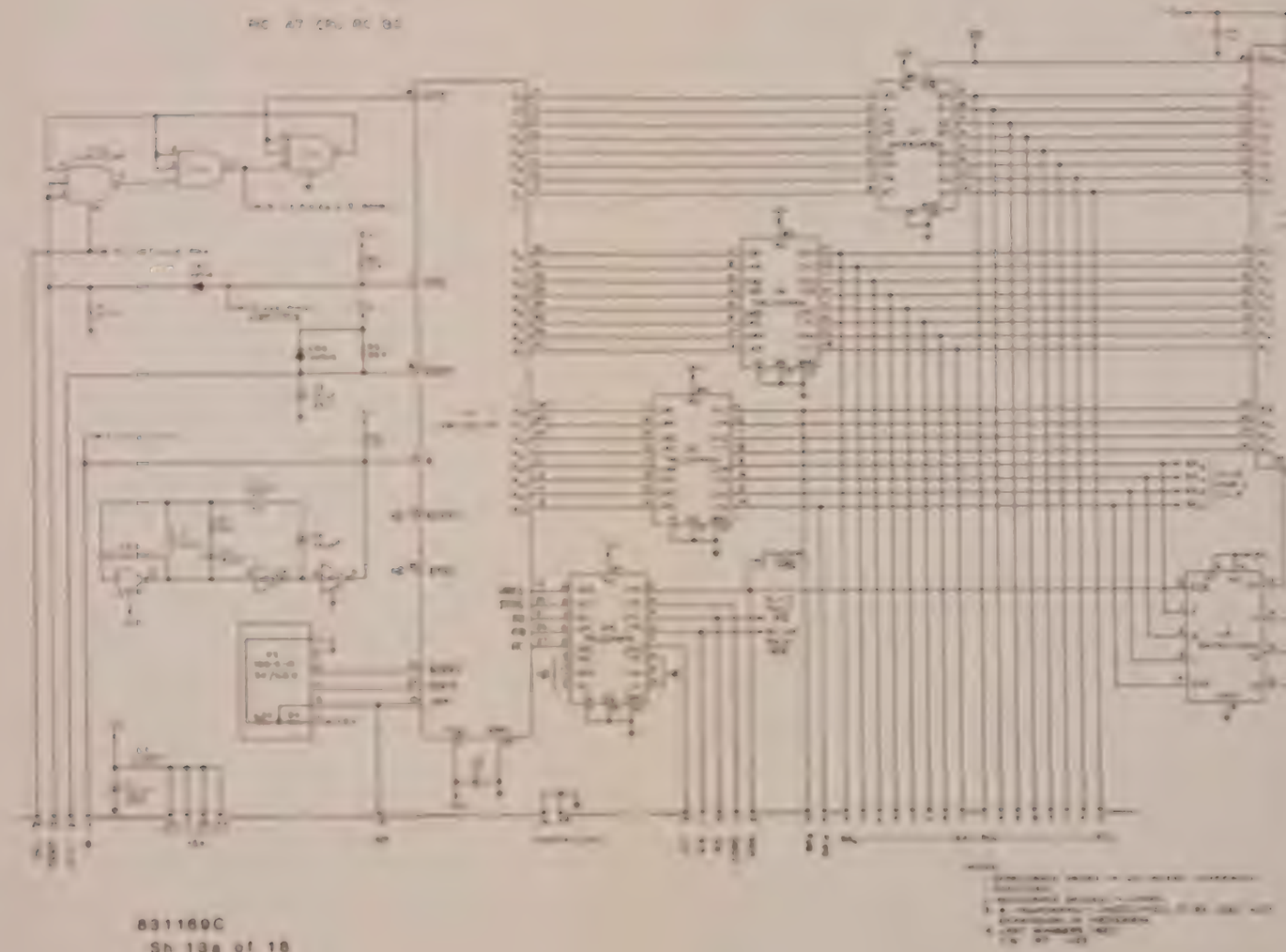
Figure 7-19. A6 I/O Schematic Diagram (Sh 1)

P/O A6 I/O P.C.BD

831169A
Sh 14b of 18

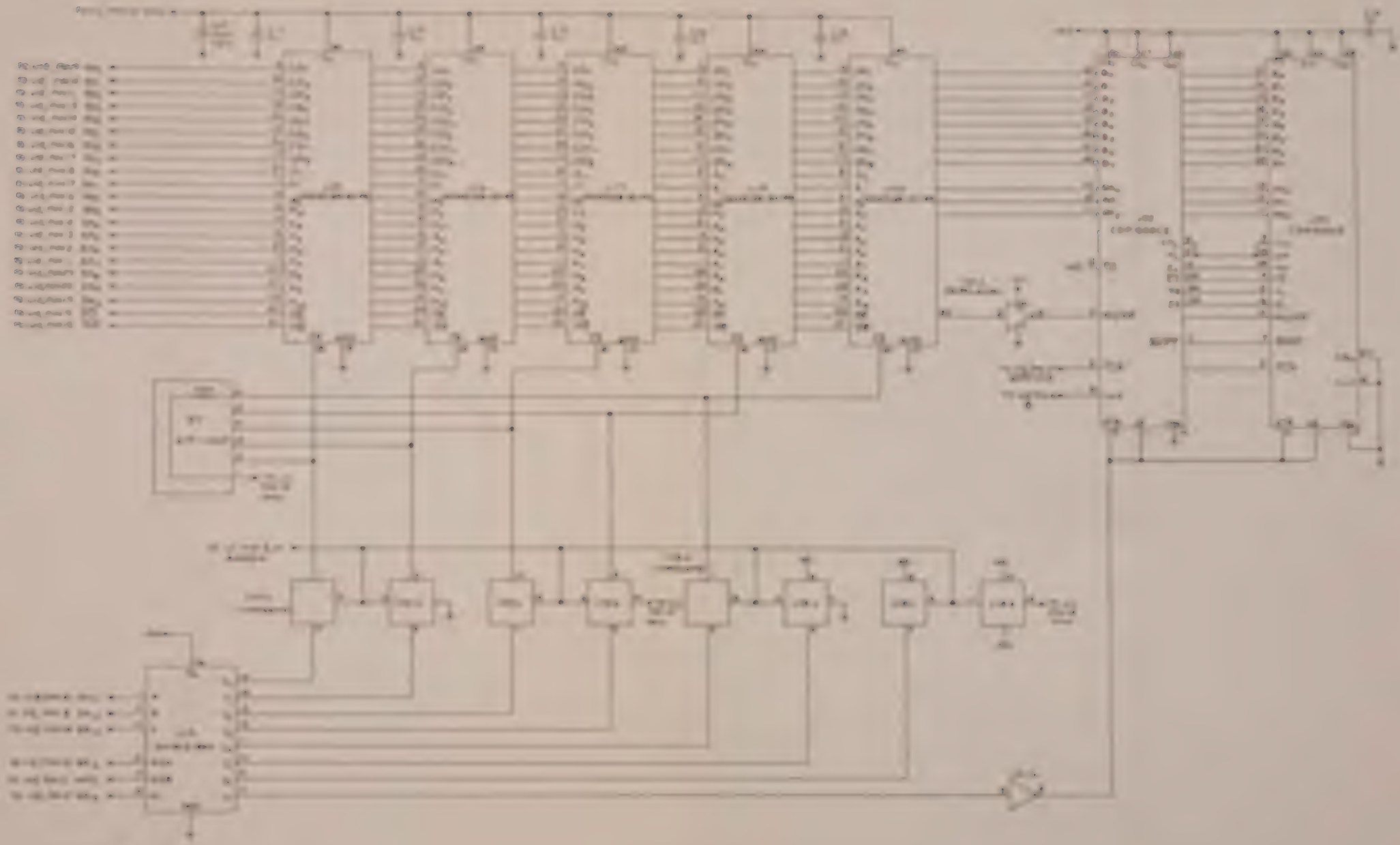
Figure 7-20. A6 I/O Schematic Diagram (Sh 2)

831286A



831169C
Sh 19a of 19

Figure 7-21. A7 CPU Schematic Diagram (Sh 1)



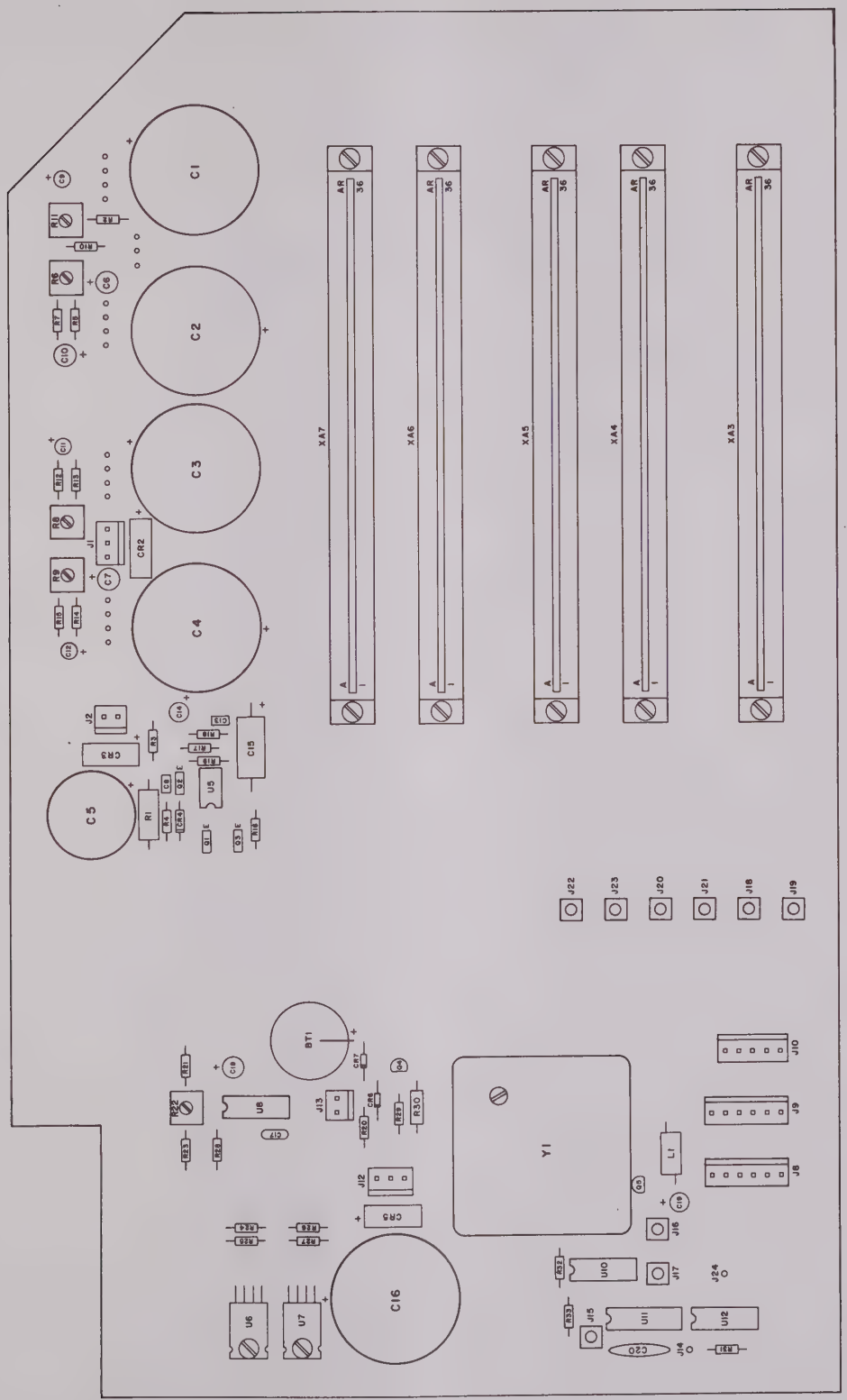
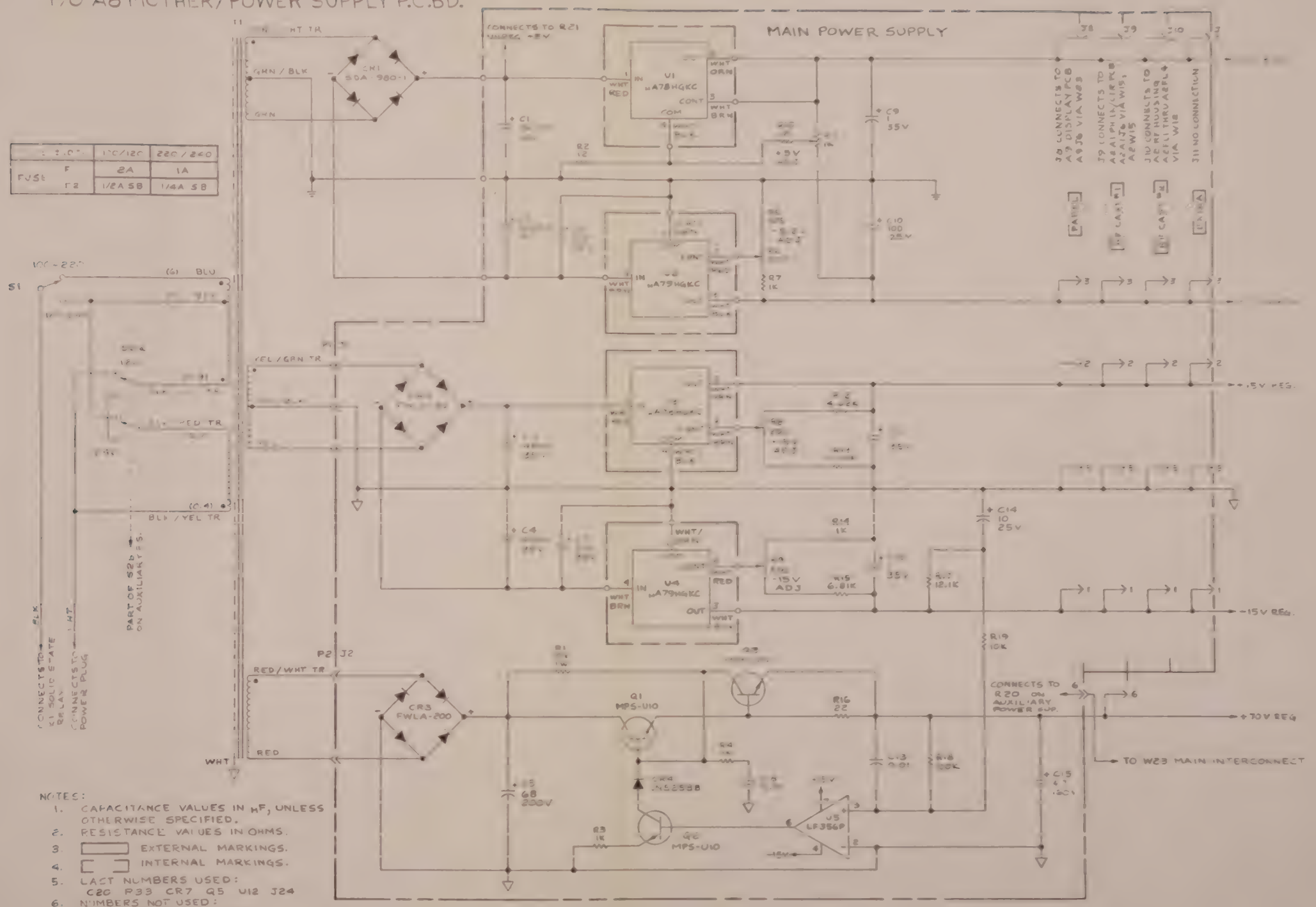


Figure 7-23. A8 Mother/PS
Overlay Diagram

P/O A8 MOTHER/POWER SUPPLY P.C.BD.

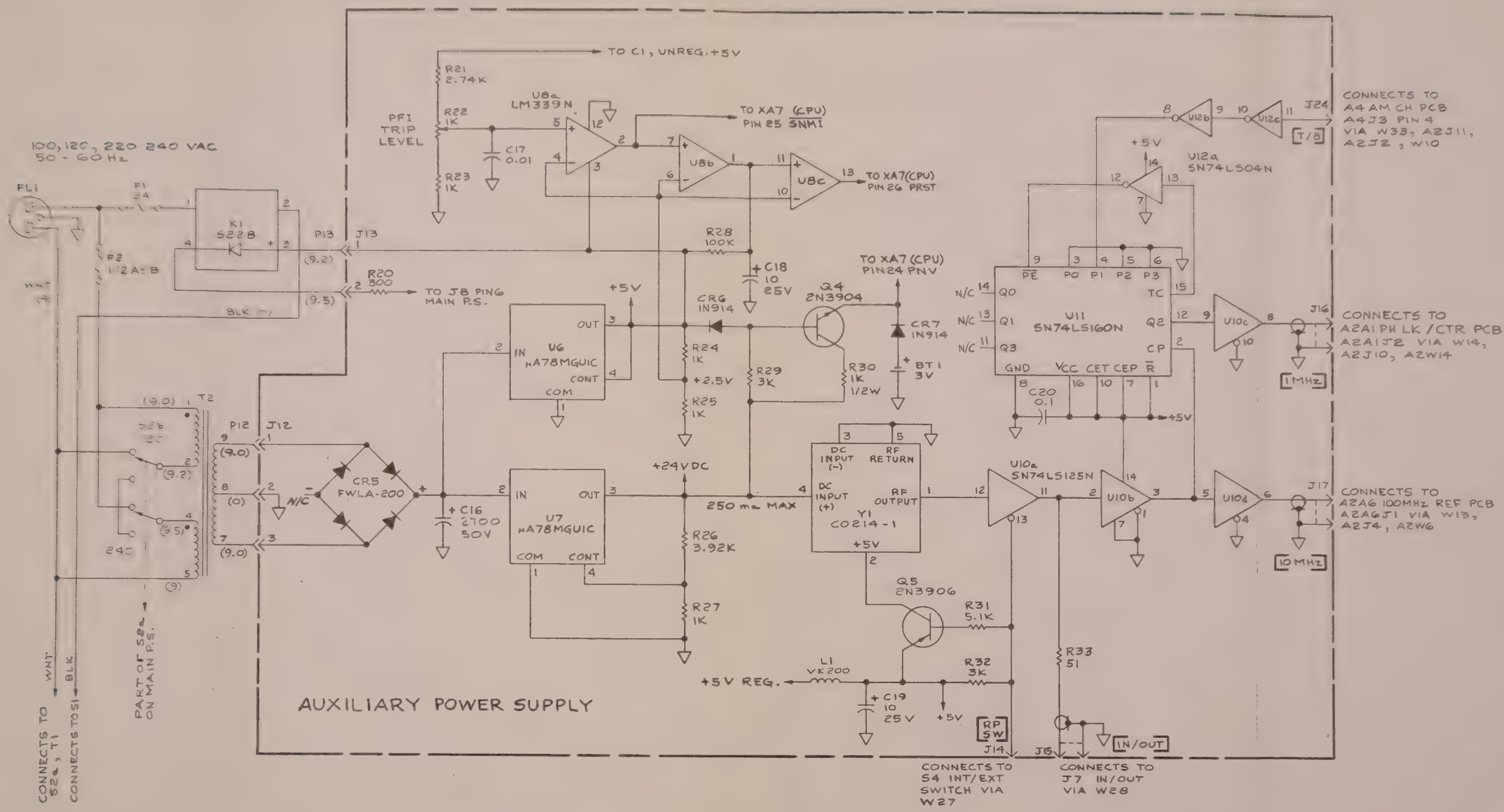


	100/120	220/240
FUSE F	2A	1A
FUSE F2	1/2A SB	1/4A SB

NOTES:
1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS.
3. ▭ EXTERNAL MARKINGS.
4. ⊏ ⊐ INTERNAL MARKINGS.
5. LAST NUMBERS USED: C20 P33 CR7 Q5 U12 J24
6. NUMBERS NOT USED: J3, P3, J4, P4, J5, P5, U9 J6, P6, J7, P7

831169F
Sh 11a of 18

Figure 7-24. A8 Mother/PS Schematic Diagram (Sh 1)



831169D
Sh 11b of 18

Figure 7-25. A8 Mother/PS Schematic Diagram (Sh 2)

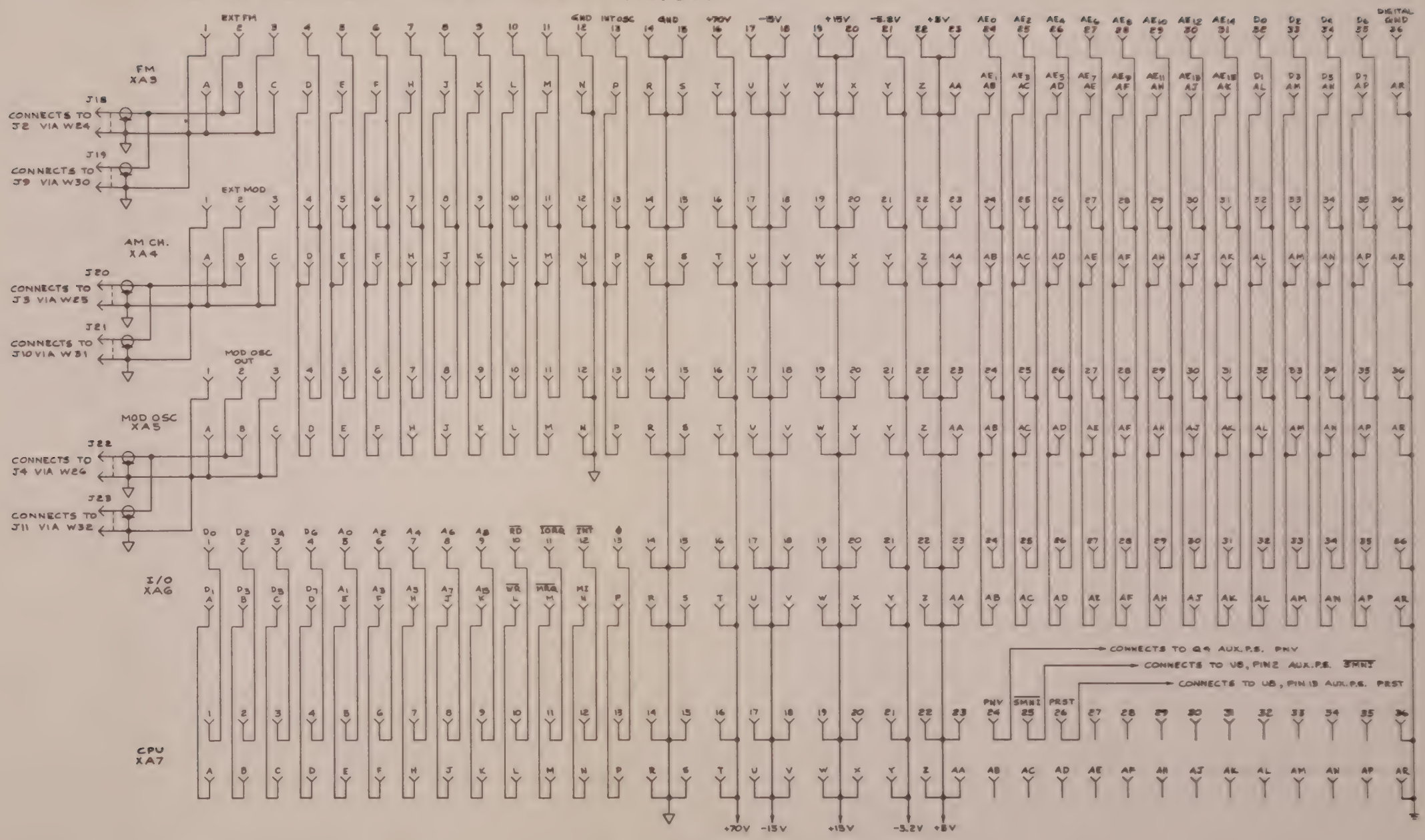
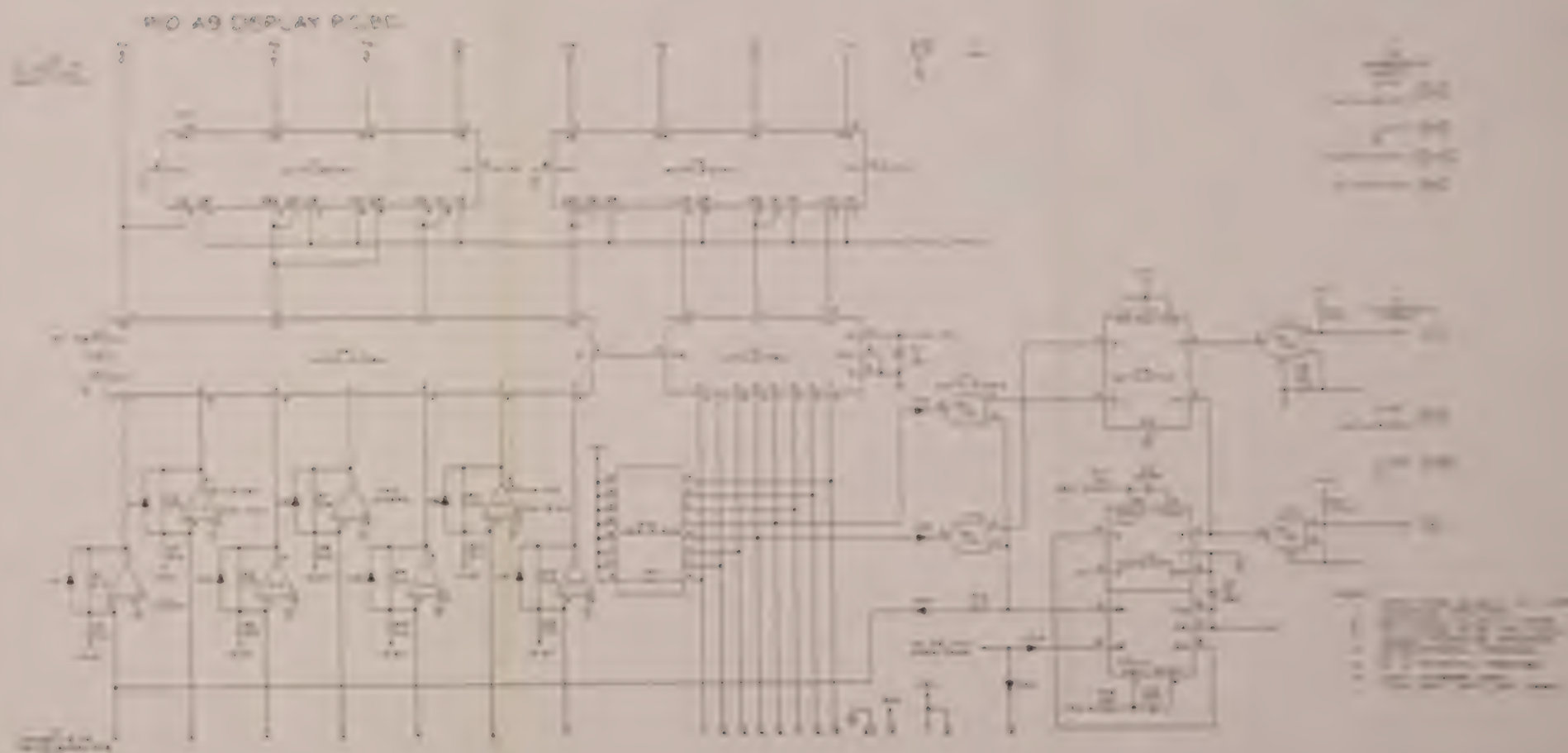
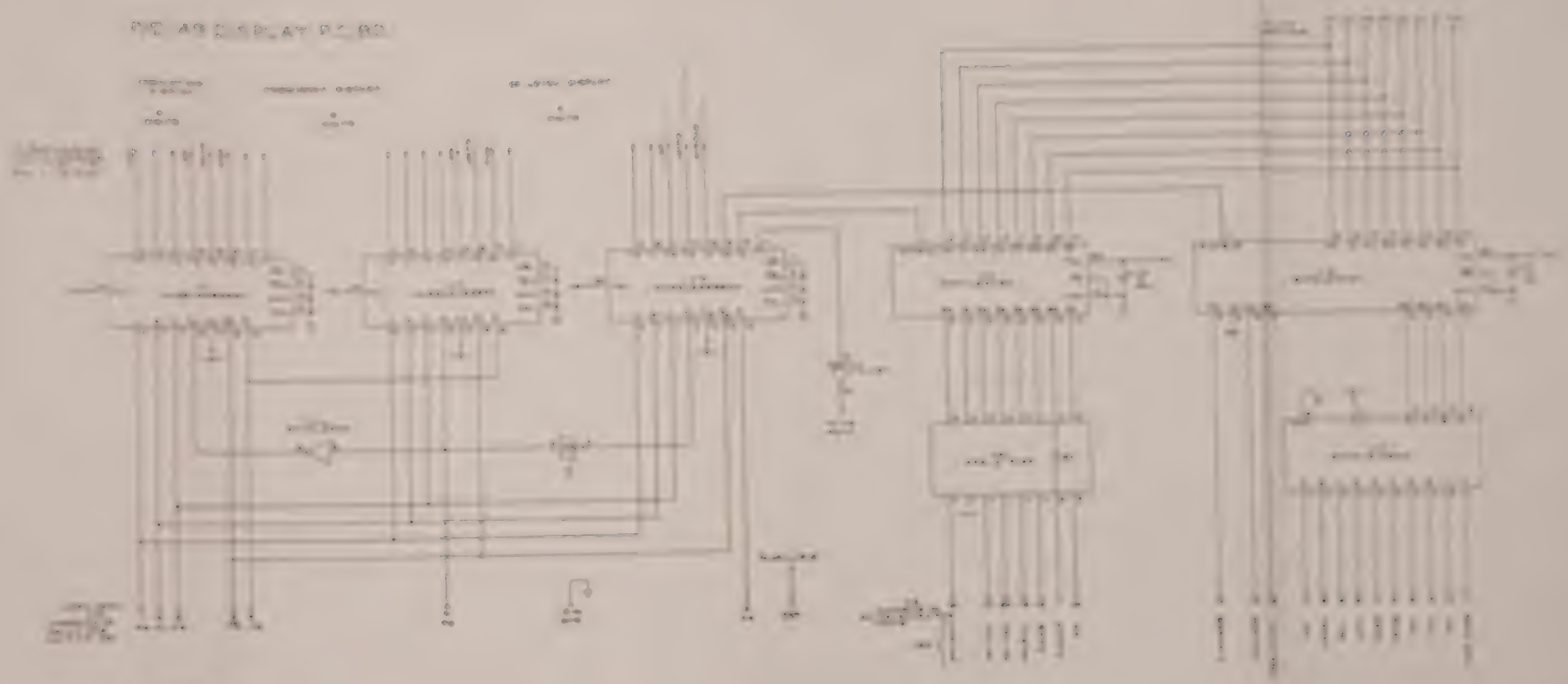


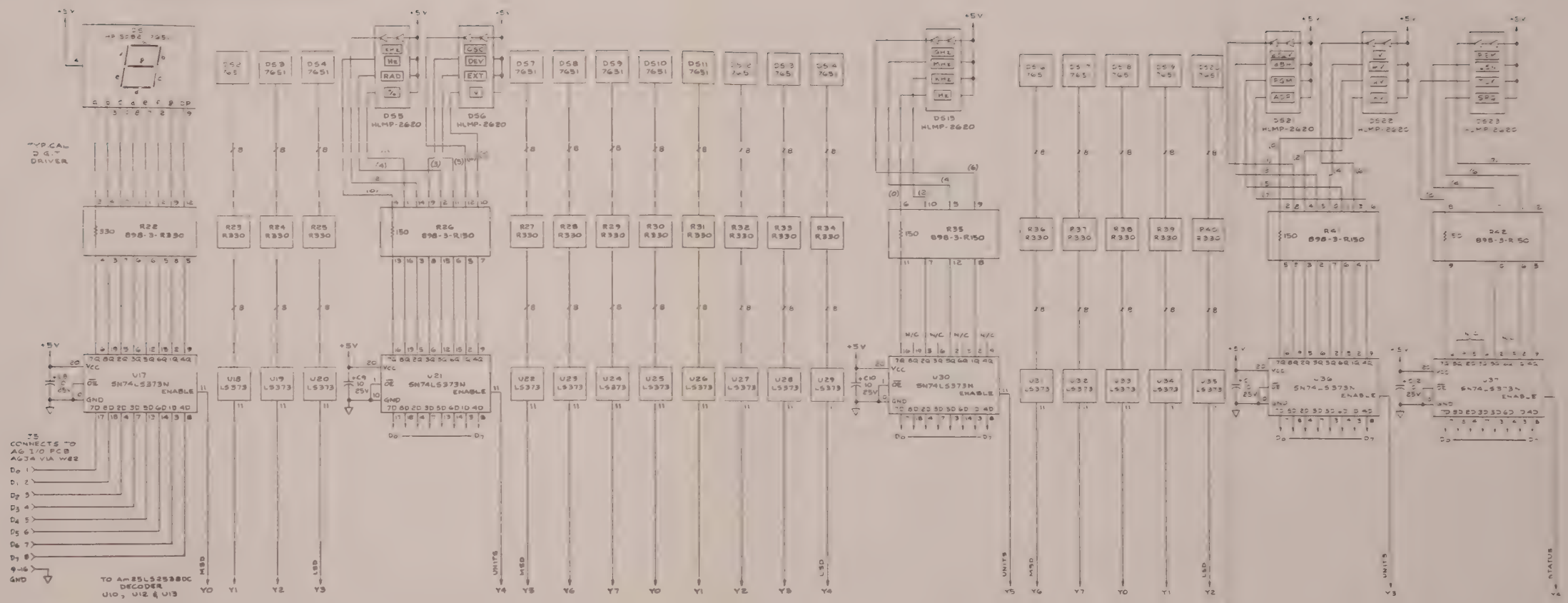
Figure 7-26. A8 Mother/PS Schematic Diagram (Sh 3)



8311609
Sh 17a of 18



P/O A9 DISPLAY P.C. BD.



831169B
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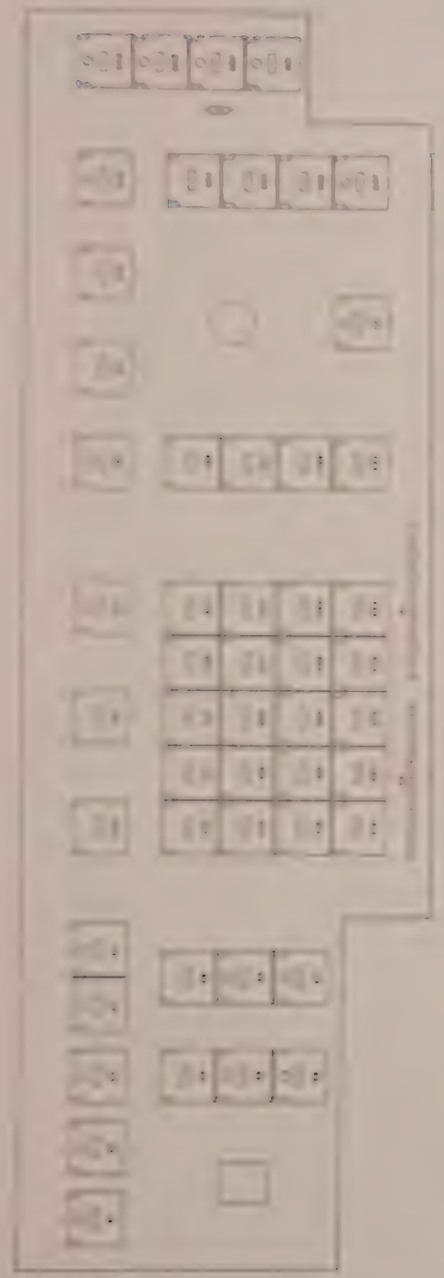
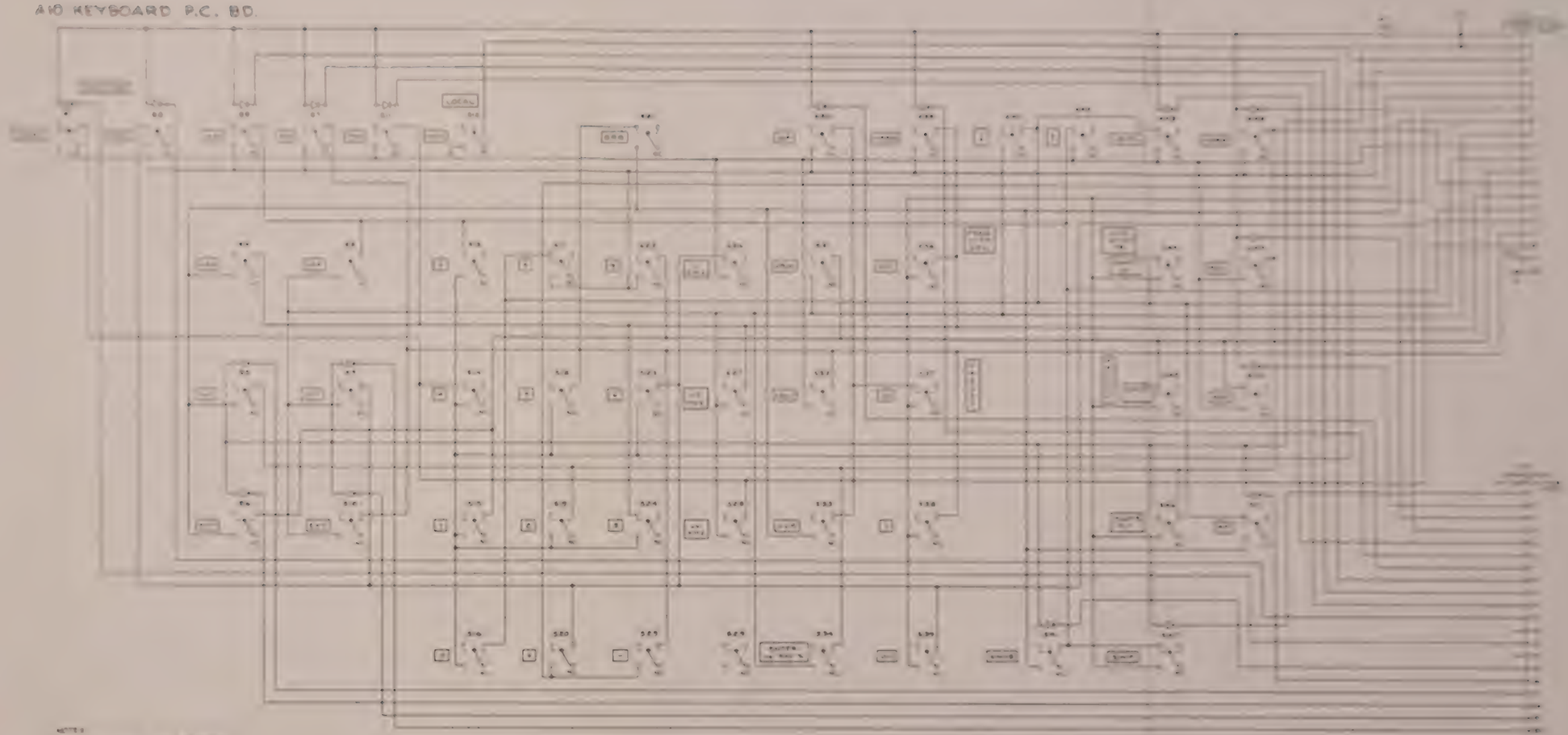
Figure 7-29. A9 Display Schematic Diagram (Sh 3)



831180A

A10 KEYBOARD P.C. BD.



831169B
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Figure 7-10. A10 Keyboard Schematic Diagram

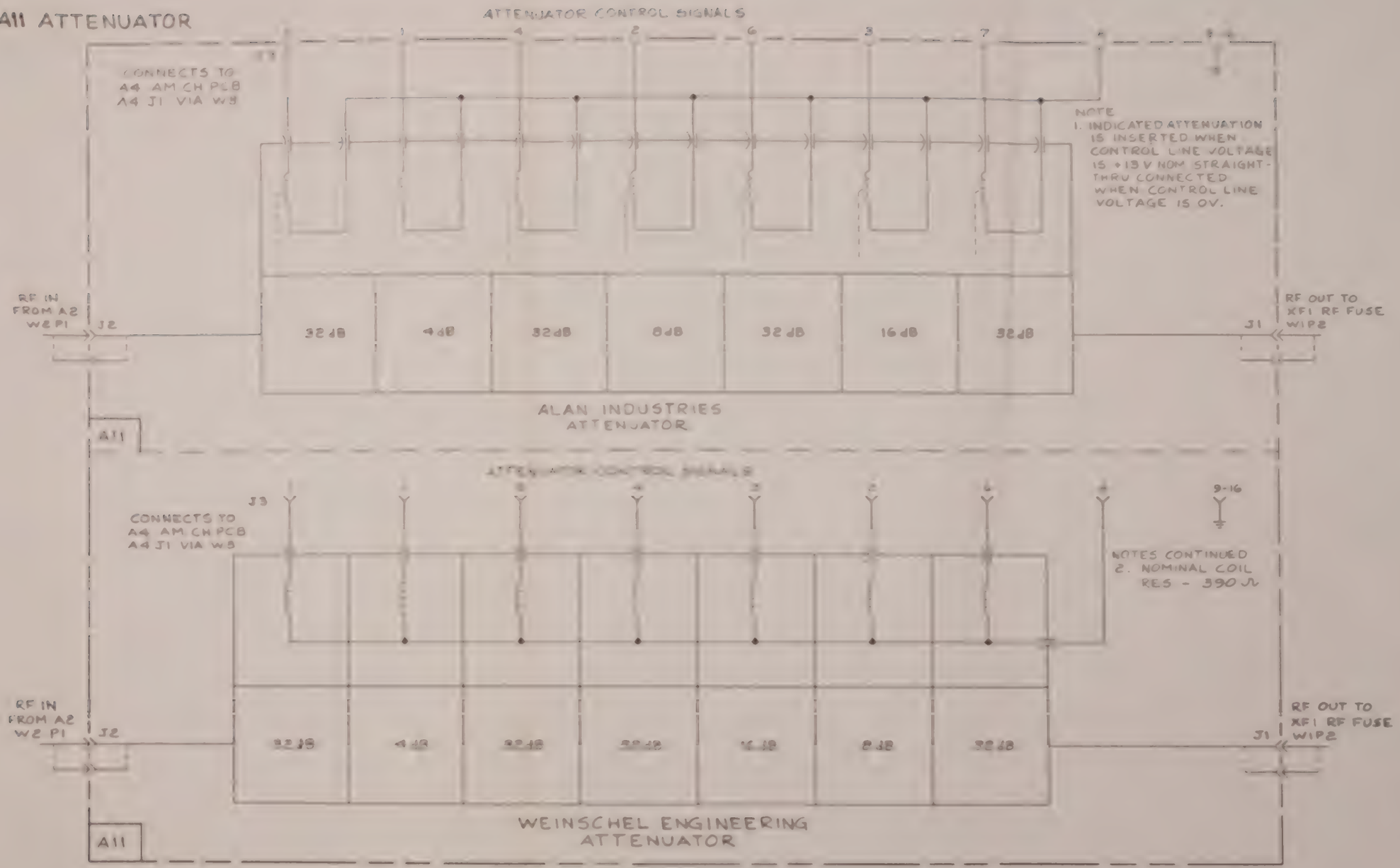


Figure 7-31. A11 Attenuator Schematic Diagram

APPENDIX A

MODEL 954011 SWEEP ACCESSORY

A-1. GENERAL DESCRIPTION.

A-2. The 954011 sweep accessory facilitates the connection of gate signals and marker signals from the sweep circuits of the signal generator and provides a convenient means for selecting sweep rates.

A-3. INSTALLATION.

A-4. The 954011 mounts on the auxilliary connector, located on the rear panel of the 1030 and is secured in place by two 4-40 x 3/4" machine screws.

NOTE

The 954011 Sweep Accessory does not interfere mechanically or electrically with the IEEE-488 bus.

A-5. GATE AND MARKER SIGNALS.

A-6. Gate signals and marker signals at TTL levels appear at the designated BNC connectors when a sweep mode is active. The logic sense of each signal is set by means of the "G" and "M" switch levers on the 954011: the "+" position makes the signal active-high; and the "-" position makes the signal active-low.

A-7. SWEEP-RATE SELECTION.

A-8. The A0 and A1 switches on the 954011 are used to select one of the four available sweep rates. Refer to Table A-1. However, these switches are read by the signal generator at the following instances only: Power ON, Initialize, and Device Clear. Consequently, if you change the switch settings there will be no immediate effect.

A-9. ANALOG SWEEP. (Using an oscilloscope or X-Y monitor).

a. Set switches A0 and A1 to the "1" position.

b. Set the generator to ANALOG SWEEP and SWP2.

c. Connect the modulation oscillator output to the X-axis or horizontal input of the display monitor.

d. Adjust the display controls for a horizontal line that extends across the entire graticule. There will be a bright dot in the center of the line. If the bright dot is not in the approximate center, the sweep is distorted. The distortion may be due to overloading of the display monitor input, or to AC coupling. (If AC coupling must be used, the cutoff frequency has to be less than 1 Hz for good results.)

e. Connect the generator RF OUTPUT to the device under test.

f. Connect the output of the device under test (or the output of the subsequent detector, if one is being used), to the Y-axis of the monitor.

NOTE

The above procedure is all that is required for a minimal system. The sweep retrace is usually invisible, or just barely visible, in this setup. However, it may be desirable with some devices under test to use one of the slower sweep rates. At the slower rates different relationships exist between trace and retrace time and the retrace is clearly visible and objectionable. The retrace can be blanked out if the display device has a Z-axis input.

g. Connect the GATE OUTPUT of the 954011 to the Z-axis input of the display device.

h. Select the proper sense of the gate output by using the "G" switch on the 954011. (If the wrong sense is selected, the trace will be blanked and the retrace will be displayed.)

i. For more advanced applications, the MARKER OUTPUT of the 954011 can be used to modify the marker intensity or to synchronize other instruments.

TABLE A-1. Sweep Rate Switch Settings

Setting		Analog Sweeps/Seconds		Digital Time/Step
(A1)	(A0)	SWP1	SWP2 & SWP3	(Milliseconds)
(*)1	1	40	61	500
1	0	65	27	110
0	1	8	10	250
0	0	2	1	800

* Default condition when the 954011 is not installed.

A-10. DIGITAL SWEEP.

a. Set switches A0 and A1 to the "1" position.

b. Set the generator to the DIGITAL SWEEP mode with any convenient parameters and recall it from memory by pressing the RCL key.

c. Connect the generator modulation oscillator output to the X-axis input of an X-Y recorder.

d. The ramp output will always start at zero and go to 10 volts. Adjust the X-Y recorder so that the pen is moved entirely across the paper by the 0 to 10 volt ramp.

e. If the recorder has a TTL compatible pen-up/pen-down input, connect it to the GATE OUTPUT of the 954011 and select the proper logic sense.

CAUTION

If the X-Y recorder is an older type that is designed for relay contact closure to lower the pen, do not connect it to the 954011 or damage may result.

f. Connect the generator RF OUTPUT to the device under test.

g. Connect the output of the device under test (or the output of the subsequent detector if one is being used) to the Y-axis of the X-Y recorder.

NOTE

Each time the SWP key is depressed, a single sweep will be recorded. If pen-lift is being utilized, the pen will be lifted at the end of the sweep and will be returned to the starting position. If pen-up/down is connected to the MARKER output instead of to the GATE output, the pen will be lowered at the end of each step to make a dot on the paper. The trace will therefore consist of series of dots. This method will eliminate the tracing of any short transients that may occur between the steps.

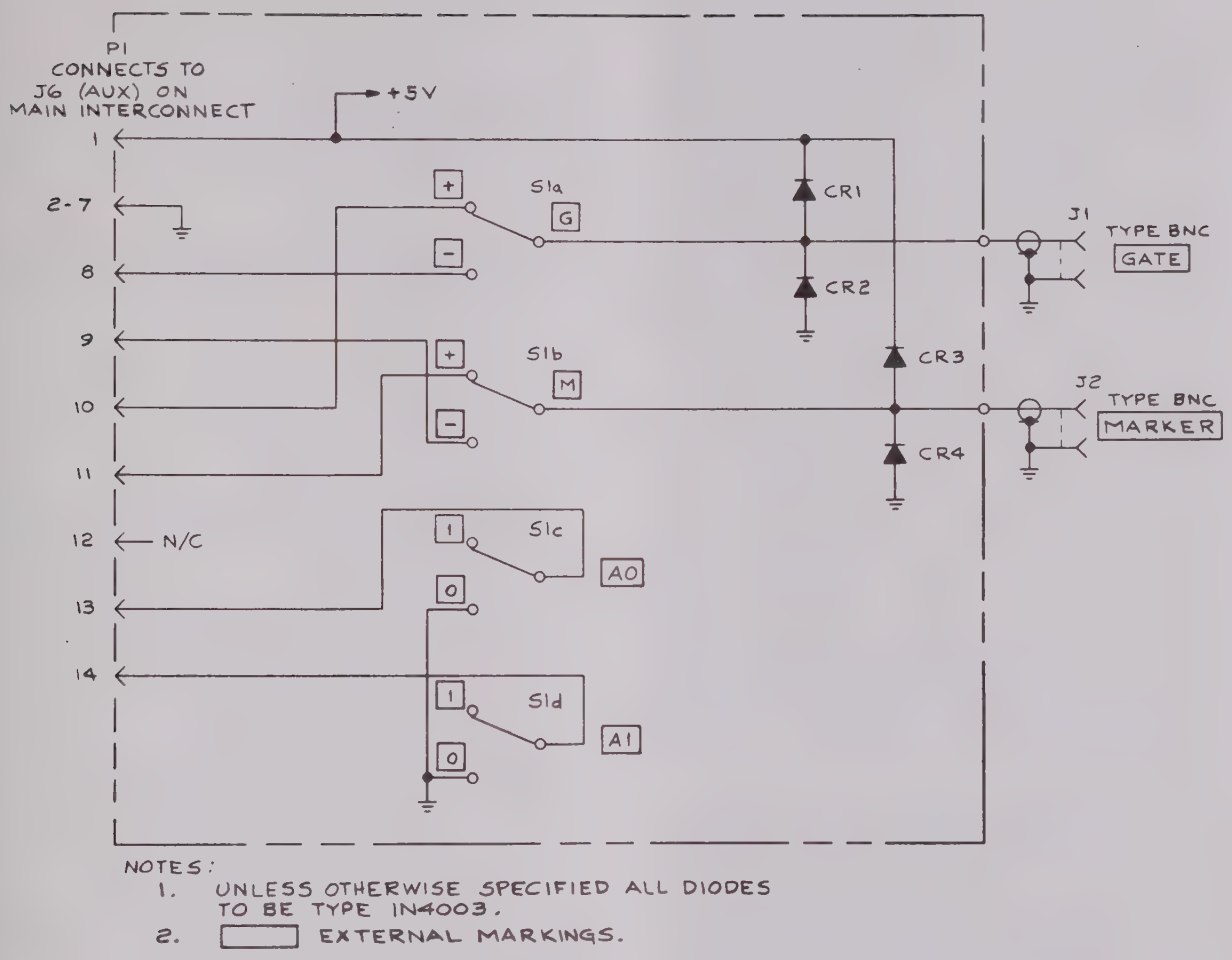
A-11. REPLACEABLE PARTS.

A-12. Table A-2. Replaceable Parts, list all the replaceable parts and includes: the reference symbol, description, mfr., mfr's part no., and the BEC part no. Table 6-1. Manufacturer's Federal Supply Code Numbers, list the manufacturer's federal supply numbers.

TABLE A-2. REPLACEABLE PARTS

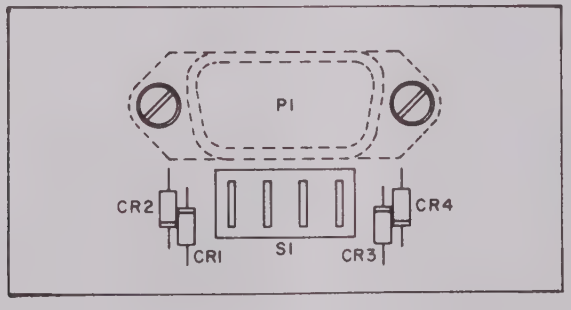
Replaceable Parts List for PWA Sweep Adapter PL 102468-00A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
CR1	Doide 1N4003	04713	1N4003 Silicon	530178-000
CR2	Doide 1N4003	04713	1N4003 Silicon	530178-000
CR3	Doide 1N4003	04713	1N4003 Silicon	530178-000
CR4	Doide 1N4003	04713	1N4003 Silicon	530178-000
P1	Connector 14 pin	32575	552209-1	477357-000
S1	Switch (4)SPDT	81073	76STC04	465291-000



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL DIODES TO BE TYPE IN4003.
2. [ ] EXTERNAL MARKINGS.



C831302A

Figure A-1. Model 954011
Sweep Accessory Schematic Diagram

APPENDIX B

MODEL 954003 KEYBOARD INTERFACE

B-1. GENERAL DESCRIPTION.

B-2. The Model 954003 keyboard interface is used with the Model RE 901 keyboard, manufactured by RE Instruments A/S, to store and recall instrument setups remotely.

NOTE

The IEEE-488 bus interface and the Model 954003 keyboard interface cannot be used simultaneously.

B-3. INSTALLATION.

B-4. Install the Model 954003 keyboard interface as follow:

CAUTION

Make sure that all power to the generator is removed before connecting or disconnecting the Model 954003 keyboard interface.

a. Set the generator POWER ON/STBY switch to the STBY position and disconnect all power.

b. Plug the Model 954003 keyboard interface into the IEEE 488 BUS and auxiliary connectors on the rear panel of the generator. Secure the Model 954003 keyboard interface to the auxiliary connector with the bolts supplied with the keyboard interface.

B-5. KEYBOARD CONNECTIONS.

B-6. If the generator is to be controlled by a single Model RE 901 keyboard, plug the 37-pin connector on the keyboard cable into the 37-pin receptacle on the Model 954003 keyboard interface. Power for the keyboard is supplied by the generator.

B-7. A larger system might include Model RE900-977 memory interface(s) and additional Model 954003 keyboard interface(s). The 37-pin common bus is extended in parallel to all interfaces. Power for the keyboard is provided by the Model RE 900-977 memory interface. A diode in the Model 954003 keyboard interface power supply line prevents reverse current flow into the generator.

B-8. INTERFACE OPERATION.

B-9. The Model 954003 keyboard interface makes use of the program store and program-recall capability of the generator. During recall, it reads the binary test number sent by the Model RE 901 keyboard and causes the instrument setup stored in the generator memory location of the same number to be recalled. During store operations it reads the test number sent by the Model RE 901 keyboard, and causes the current generator setup to be stored in the program location of the same number. Setups stored in this way do not differ from set-ups stored manually or by the IEEE 488 bus interface; therefore, stored setups can be exchanged among the various environments. Although the generator has storage locations for up to 250 setups, not all of these locations are accessible through the keyboard interface because of the following peripheral equipment limitations:

a. The Model RE 901 keyboard is limited to test numbers 0 through 99.

b. The Model RE 900-997 memory interface is limited numbers 0 through 63.

c. The Model 954003 keyboard interface can accept test numbers from 0 through 127.

B-10. KEYBOARD OPERATION.

B-11. Operation of the Model RE 901 keyboard with the Model 9545003 keyboard interface is as described in RE Instruments publication "901 Keyboard and Memory Interface", Second Edition, Section B, with the following modifications:

a. When the generator is turned ON, it will not automatically set up to location 0. Test number 00 must be entered on the keyboard.

b. Test numbers up to 99 can be used; however, if the system includes the Model RE 900-977 memory interface, the highest usable test number may be 63. (Refer to the appropriate RE Instruments publication for the interface being used.)

c. The error control of the generator will operate the out-of-range indicator if the Error Service Request function is enabled.

d. The RF-level vernier has no effect on, or connection with, the generator.

B-12. CIRCUIT DESCRIPTION.
(see Figure B-1.)

B-13. The 7-bit binary number entered through the keyboard is applied to latch U3. The latch is clocked through inverter U1a by signal RDY from the keyboard. When the latch is clocked, a data-ready signal is supplied through inverter U1b to the generator and the test number is available at the output of the latch for use by the generator. A keyboard inhibit signal is also sent to the keyboard through inverter U1b and driver U2a. After the generator has read the number, it clears latch U3, thereby clearing the data-ready and keyboard-inhibit signals.

B-14. Signal REMOTE from the keyboard is supplied to the generator through driver U2c, and the keyboard out-of-range indicator is controlled through driver U2b by the generator. Both drivers are open-collector types. The other signals on the 37-pin bus, which are used by the Model RE 900-977 memory interface(s) are not connected to the Model 954003 keyboard interface. Power is supplied to the keyboard from the generator +5 volt supply through diode CR1, which protects against reverse-current flow if a connection is made which, in effect, connects an external supply in parallel.

B-15. REPLACEABLE PARTS.

B-16. Table B-1. Replaceable Parts, list all the replaceable parts and includes: the reference symbol, description, mfr., mfr's part no., and the BEC part no. Table 6-1. Manufacturer's Federal Supply Code Numbers, list the manufacturer's federal supply numbers.

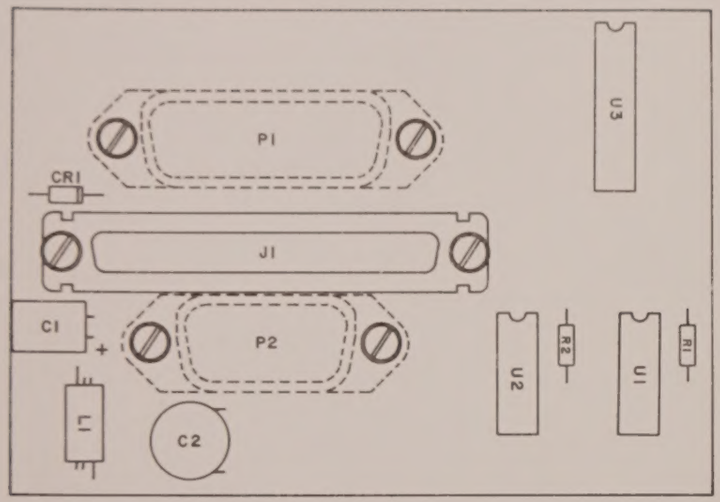
TABLE B-1. REPLACEABLE PARTS

Replaceable Parts List for Rm Interface Module Assembly PL 102505-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
J2	Connector BNC	54420	UG-625/U	479123-000

Replaceable Parts List for PWA Rm Interface PL 102509-01A

Reference Symbol	Description	Mfr.	Mfr's Part No.	BEC Part No.
C1	Capacitor EL 100 µF 20% 25V	S4217	SM-25-VB-100-M	283334-000
C2	Capacitor Cer 0.1 µF 20% 25V	51406	DD312E10Y5P104M25V	224364-000
CR1	Diode IN4003	04713	IN4003 Silicon	530178-000
J1	Connector 37 pin		DCC-37S-BB (Cannon)	479386-000
L1	Inductor Wideband VK200/19-4B	02114	VK200/19-4B	400410-000
P1	Connector 24 pin	32575	552221-1	477356-000
P2	Connector 14 pin	32575	552209-1	477357-000
R1	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
R2	Resistor MF 10.0k ohm 1%	---	RN55D-1002-F	341400-000
U1	IC 74LS04N Hex Inverter	01295	SN74LS04N	534155-000
U2	IC 7407N HEX Buffer Open Collector	01295	SN7407N	534066-000
U3	IC SN74LS273N	01295	SN74LS273N Octal	534263-000
XU1	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU2	Socket IC 14 Pin	06776	ICN-143-S3-G	473019-000
XU3	Socket IC 20 Pin	06776	ICN-203-S3-G	473065-000



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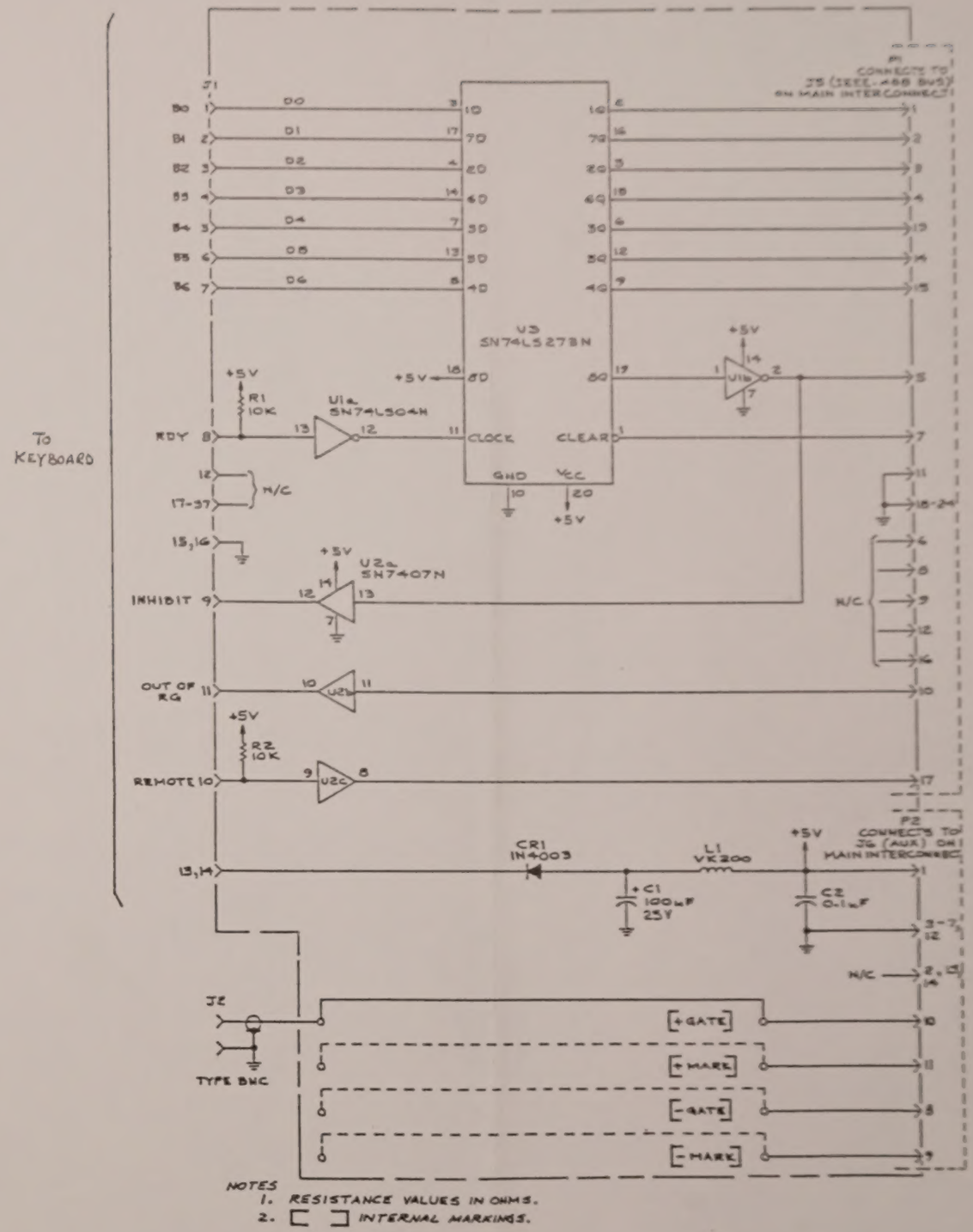

Figure B-1. Model 954003 Keyboard Interface Schematic Diagram

WARRANTY

Boonton Electronics Corporation warrants its products to the original purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to active devices that have given normal service, to sealed assemblies which have been opened or to any item which has been repaired or altered without our authorization.

We will repair, or at our option, replace any of our products which are found to be defective under the terms of this warranty.

There will be no charge for parts, labor, or forward and return normal ground transportation during the first three months of this warranty.*

There will be no charge for parts, labor, or return normal ground transportation during the fourth through twelfth month of this warranty.*

Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

*For *overseas shipments,* there will be no charge for Air Freight during these specified time periods.

BOONTON

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